llinois U Library

JUNE · 1953

roceedings of the I·R·E

ournal of Communications and Electronic Engineering

MAMMOTH RADIO MIRROR

Official United States Navy Photograph

rfing the 200-inch reflector of the largest optical telescope,
600-inch radio telescope atop the Naval Research Labo-
y in Washington is adapted to receive stellar and inter-
ar radiation of from about 0.85-cm to 30-cm wave lengths
ts paraboloidal aluminum mirror.

Volume 41 Number 6

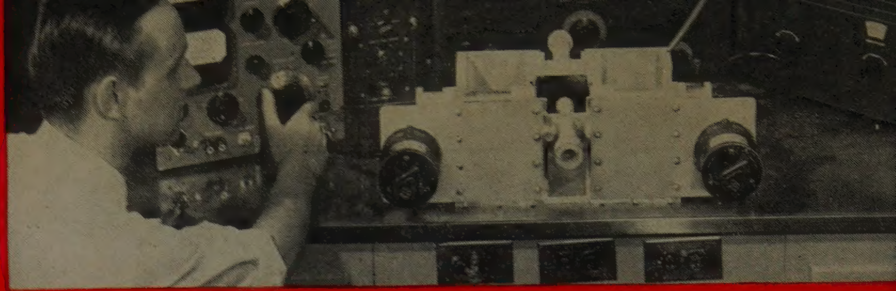
IN THIS ISSUE

Transistor Circuits for Television
Symmetrical Properties of Transistors
Transistor Negative-Impedance Converters
Flying-Spot Color Signal Generator
Aircraft Navigation Computer
Push-Pull Audio Amplifier
Informational Capacities of AM and PM Systems
Distributed Amplifier Theory
Calculations of a Magnetron Resonator
Pulses Per Beamwidth for Radar
Moving Pole in Nonlinear Oscillating Systems
Insertion Loss of Ladder Filters
Field of a Ring Quasi-Array
Optimum Array for a Single Beam
Abstracts and References

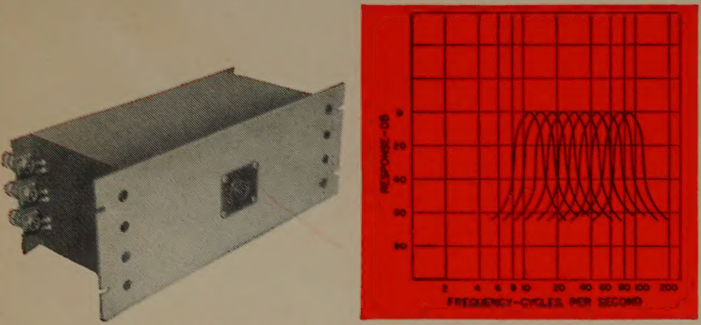
TABLE OF CONTENTS INDICATED BY BLACK-AND-WHITE MARGIN, FOLLOWS PAGE 64A

he Institute of Radio Engineers

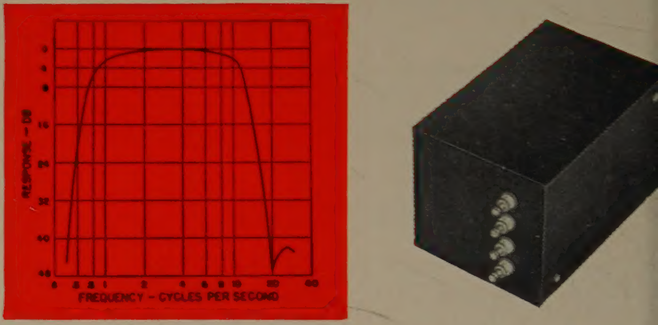
for SPECIALIZED FILTERS



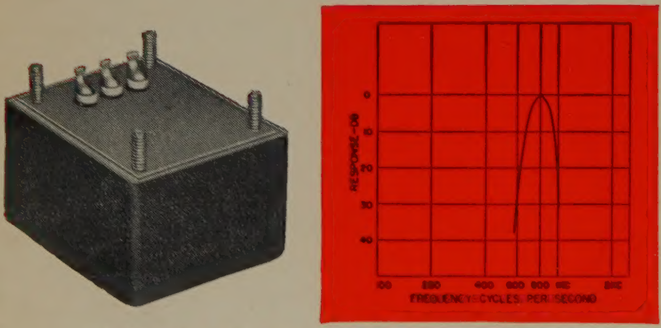
Decades of experience in the design and production of specialized filters have resulted in UTC being a first source for difficult filters. Fifteen years ago UTC was already the largest user of permalloy dust toroids in the world (exclusive of the telephone system). Present designs include a wide variety of core materials, structures, and winding methods to provide maximum performance in electrical requirements and stability. Illustrated below are a few of the thousands of special filter designs in present production.



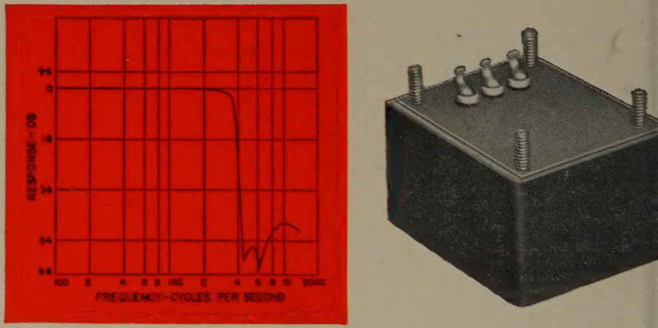
These low frequency band pass filters are held to 1 DB tolerance at the 3 DB crossover . . . 600 ohm . . . 4 filters per 7½" rack panel.



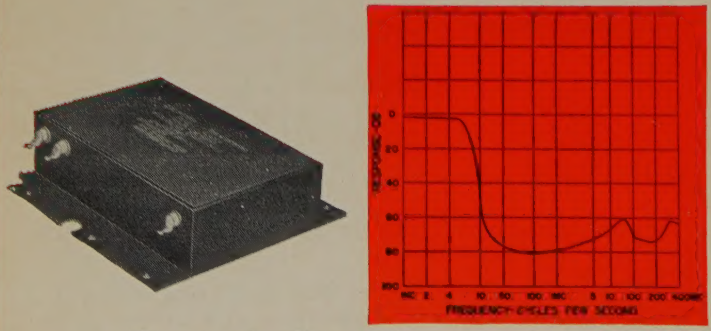
This ultra low frequency filter has a band pass range of one cycle to 10 cycles . . . 50,000 ohms . . . 700 cubic inches.



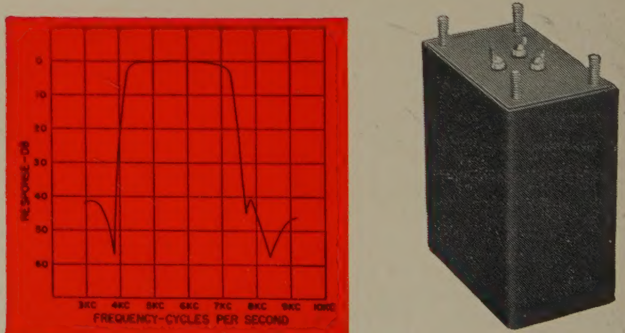
This 600 ohm miniaturized 1 KC band pass filter is housed in a case only 1" x 1¾" x 2½".



This 600 ohm miniaturized low pass filter is housed in a case only 1" x 1¾" x 2½".



This power line filter provides correct output voltages from sources of 50 to 400 cycles . . . noise attenuation is from 14 KC to 400 MC . . . 29 cubic inches.



This band pass filter is designed for sharp cut-off at both ends of the range . . . 10,000 ohms . . . case dimensions 1⅝" x 2½" x 3¼".

United Transformer Co.

150 VARICK STREET NEW YORK 13, N. Y.

PROCEEDINGS OF THE I.R.E.®

Published Monthly by

The Institute of Radio Engineers, Inc.

VOLUME 41 — *June, 1953* — NUMBER 6

PROCEEDINGS OF THE I.R.E.

Ralph D. Bennett, Director, 1953 706
Student Guidance .... John L. Callahan 707
4585. A Study of Transistor Circuits for Television .... G. C. Sziklai, R. D. Lohman, and G. B. Herzog 708
4586. Symmetrical Properties of Transistors and Their Applications .... George Clifford Sziklai 717
4587. Transistor Negative-Impedance Converters .... J. G. Linvill 725
4588. Measurement and Control of the Color Characteristics of a Flying-Spot Color Signal Generator .... R. C. Moore, J. F. Fisher, and J. B. Chatten 730
4589. Punched-Card Controlled Aircraft Navigation Computer .... E. H. Fritze 734
4590. Analysis of a Single-Ended Push-Pull Audio Amplifier . . Chai Yeh 743
4591. A Comparison of the Informational Capacities of Amplitude- and Phase-Modulation Communication Systems . . Nelson M. Blachman 748
4592. Distributed Amplifier Theory .... Delmar V. Payne 759
4593. Calculation of a Waveguide-Loaded Resonator for Interdigital Magnetrons .... Gunnar Hok 763
4594. The Effective Number of Pulses Per Beamwidth for a Scanning Radar .... Lamont V. Blake 770
4595. A Note on Moving Poles in Nonlinear Oscillating System .... William B. Wrigley 774
4596. The Effects of Terminations and Dissipation on the Insertion Loss of Some Simple Ladder Filters .... M. Strasberg 777
4597. The Field Radiated by a Ring Quasi-Array of an Infinite Number of Tangential or Radial Dipoles .... H. Lottrup Knudsen 781
4598. Discussion on "Design Procedures for Pi-Network Antenna Couplers" by Leo Storch .... J. E. Wolfe and Leo Storch 790
4599. The Optimum Linear Array for a Single Main Beam . D. R. Rhodes 793
Contributors to PROCEEDINGS OF THE I.R.E. 794

Correspondence:

4600. "Network Definitions" .... D. A. Bell 797
4601. "A Method of Obtaining 90° Phase Shift of Constant Amplitude" .... Sid Deutsch 797
4602. "Frequency Spectrum of a Pulled Oscillator" .... Alfred G. Simms 798
4603. "A Note on the Circular Dieletric-Disk Antenna" . . E. M. T. Jones 798
4604. "Inverted Magnetron" .... F. Ludi 799
4605. "Resistive Bidirectional Coupler" .... Louis Rosenthal 799
4606. "A Simple Proof of the Formula for the Relative Accuracy of a Noise Power Measurement with a Quadratic Detector" .... A. van der Ziel 800
4607. "Degenerative Pentode Equivalent Circuit" .... Harry Stockman 801
4608. "More on the RC Oscillator" .... William J. Wray, Jr. 801

INSTITUTE NEWS AND RADIO NOTES SECTION

Technical Committee Notes 802
Professional Groups News 803
TRANSACTIONS of the IRE Professional Groups 805
IRE People 806
Report of the Secretary—1952 808
Institute Committees—1953 811
Technical Committees—1953–1954 812
Institute Representatives in Colleges—1953 816
Institute Representatives on Other Bodies—1953 817
4609. Abstracts and References 818
Meetings with Exhibits 2A
News—New Products 12A
Industrial Engineering Notes . . 66A
Section Meetings 86A
Student Branch Meetings 92A
Membership 102A
Positions Open 128A
Positions Wanted 143A
Advertising Index 158A

BOARD OF
DIRECTORS, 1953

J. W. McRae
President

S. R. Kantebet
Vice-President

W. R. G. Baker
Treasurer

Haraden Pratt
Secretary

Alfred N. Goldsmith
Editor

I. S. Coggeshall
Senior Past President

D. B. Sinclair
Junior Past President

1953

R. D. Bennett
G. H. Browning (R1)
W. H. Doherty
A. W. Graf (R5)
W. R. Hewlett
A. V. Loughren
R. L. Sink (R7)
G. R. Town
Irving Wolff (R3)

1953–1954

J. T. Henderson (R8)
C. A. Priest (R4)
J. R. Ragazzini (R2)
J. D. Ryder
A. W. Straiton (R6)
Ernst Weber

1953–1955

S. L. Bailey
B. E. Shackelford

●

Harold R. Zeamans
General Counsel

●

George W. Bailey
Executive Secretary

Laurence G. Cumming
Technical Secretary

●

Changes of address (with advance notice of fifteen days) and communications regarding subscriptions and payments should be mailed to the Secretary of the Institute, at 450 Ahnaip St., Menasha, Wisconsin, or 1 East 79 Street, New York 21, N. Y.

All rights of publication, including translation into foreign languages, are reserved by the Institute. Abstracts of papers with mention of their source may be printed. Requests for republication privileges should be addressed to The Institute of Radio Engineers.

EDITORIAL
DEPARTMENT

Alfred N. Goldsmith
Editor

E. K. Gannett
Administrative Editor

Marita D. Sands
Assistant Editor

●

ADVERTISING
DEPARTMENT

William C. Copp
Advertising Manager

Lillian Petranek
Assistant Advertising Manager

●

BOARD OF EDITORS

Alfred N. Goldsmith
Chairman

PAPERS REVIEW
COMMITTEE

George F. Metcalf
Chairman

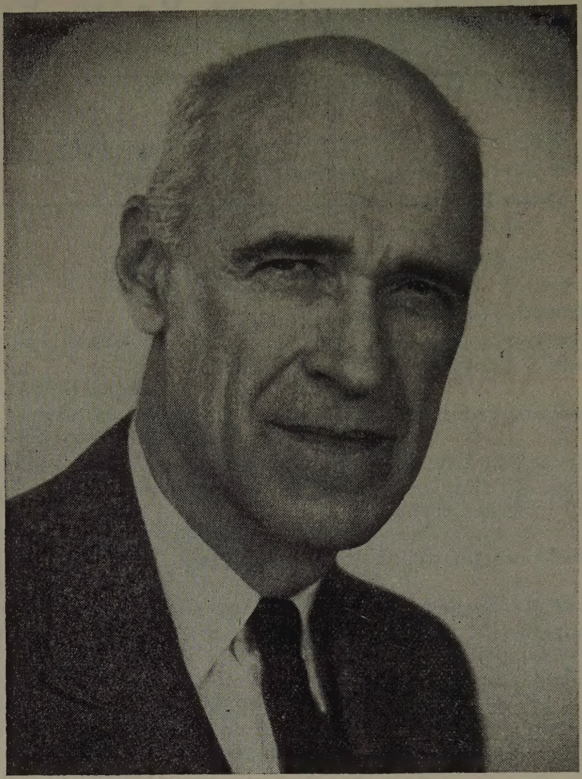
ADMINISTRATIVE
COMMITTEE OF THE
BOARD OF EDITORS

Alfred N. Goldsmith
Chairman

Reg. U. S. Pat. Off.

Responsibility for the contents of papers published in the PROCEEDINGS OF THE I.R.E. rests upon the authors. Statements made in papers are not binding on the Institute or its members.

Copyright, 1953 by The Institute of Radio Engineers, Inc.



Ralph D. Bennett

Director, 1953

Ralph D. Bennett was born in Williamson, New York, on June 30, 1900. He received the B.S. and M.S. degrees in electrical engineering from Union College, Schenectady, N. Y., in 1921 and 1923, respectively, and an honorary D.Sc. in 1945. He received a Ph.D. in physics from the University of Chicago in 1925.

Dr. Bennett began his teaching experience at Union in 1921–23 as an instructor, returning in 1925–1926 as an assistant professor of physics. During 1926–27 he was a National Research Fellow at Princeton University, working on Geiger counters and associated apparatus. The following year he continued his Fellowship at the California Institute of Technology, where he engaged in the development of one of the first really high voltage X-ray tubes. From 1928 to 1931 he was research associate at the University of Chicago, studying the basic properties of insulating materials, and developing new methods and instruments for the measurement of cosmic rays.

As associate professor of electrical measurements at the Massachusetts Institute of Technology from 1931–36 Dr. Bennett directed the organization and expansion of the Electrical Measurements Laboratory. He continued his work on cosmic-ray measuring methods and equipment, and in the summer of 1932 headed an extensive cosmic-ray expedition through Alaska and western United States, and in 1934, to Colorado. As full professor, he administrated graduate research in the electrical engineering department until 1940.

Commissioned a lieutenant commander in the United States Naval Reserve in 1936, Dr. Bennett was on active duty at the Naval Ordnance Laboratory from 1940–47, rising to the rank of captain. He has been technical director of the Laboratory since 1944, presently as a civilian.

Dr. Bennett joined the Institute in 1944 as a Senior Member, and was elected a Fellow in 1952.

Dr. Bennett holds the Legion Merit Medal, the United States Navy Distinguished Civilian Service Award, is an Officer of the British Empire, and a life trustee of Union College.

Student Guidance

John L. Callahan

The engineering student of today will be the professional engineer of tomorrow. In the minds and hands of students rests the future of technological development and accomplishment.

Every wise step taken by engineering societies to assist the student engineer in his university activities and to help prepare him for his future career is therefore literally a contribution to the welfare of humanity.

Concrete plans along these lines are described in the following illuminating guest editorial written by a Fellow of the Institute, who is assistant to the director of the Radio Research Laboratory, Radio Corporation of America, RCA Laboratories Division, New York, New York.—*The Editor*

During the past few years professional societies, industrial concerns, and governmental agencies have viewed with increasing alarm the rapid depletion of available engineering man-power. Despite the fact that some sound alleviative measures have been proposed and put into operation, statistics not only continue to reflect a vast present shortage, but predict an even gloomier future. A nationwide survey made by the Engineering Manpower Commission, under the auspices of the Engineers' Joint Council, has indicated that, unless there is a sharp decline in defense activity, the annual output of engineering graduates will fall far short of national requirements for many years to come.

Obviously, then, it is vital that we as practicing engineers make every effort to develop the "natural resources" of our profession—the embryo engineer. We, as individuals and as a group, must assist in guiding potential engineering talent into the branch and subdivision of the profession where it will be most productive, most useful and, perhaps of primary importance, most happy.

An outstanding example of such assistance is the work done by the New York Engineers' Committee on Student Guidance, operating since 1936 under the auspices of the Engineers' Council for Professional Development. This Committee consists of practicing engineers who, in recognition of the overwhelming need for reliable, factual engineering guidance information in the high schools, have undertaken a program designed to help the student decide whether or not he should prepare himself for an engineering career. The Committee does not try to "sell" engineering; in co-operation with the schools, it merely furnishes information to help the high school student reach an intelligent decision. It is just as important to show an unqualified student why he should not enter engineering as it is to guide a student with engineering talent into his proper niche in the profession.

It is not the aim of the Committee to take engineering guidance out of the hands of the high school guidance counselors, but rather to co-operate closely with the counselors. Briefly outlined, the manner of operation is this: The high school counselor organizes a meeting of students who are interested in engineering and requests a Committee "panel" for the meeting. A panel usually consists of one representative of each of the basic engineering branches. One of the representatives, acting as chairman, opens the meeting with a brief, generalized "lead talk," detailing the requirements for a successful engineering career, the types of work involved and the remuneration which may be expected. Each panel member then speaks about his particular branch of the profession. A question-and-answer period follows. A large meeting is often divided into sections during the question-and-answer period, so that the student may gain as much knowledge as possible about the branch of engineering in which he is most interested. It may be added that these meetings have been highly successful.

The New York Engineers' Committee on Student Guidance is merely one example of a very vital activity; there are other groups doing good work along similar lines. However, the purpose of this example is to show what the individual practicing engineer can do to help secure a continuing supply of talent for his ever-expanding profession.

A Study of Transistor Circuits for Television*

G. C. SZIKLAI†, SENIOR MEMBER, IRE, R. D. LOHMAN†, AND G. B. HERZOG†

***Summary*—This paper describes a general study of transistors in television receivers. For this purpose the development of a completely transistorized television receiver was undertaken. An experimental model using 37 developmental transistors and a five-inch kinescope housed in a cabinet 13×12×7 inches was constructed. This portable receiver operates on a single channel using a self-contained loop, and has a total battery-power consumption of 13 watts, more than 25 per cent of which is consumed by the kinescope heater.**

The development of a complete experimental receiver, even with a number of compromises, provided an opportunity to deal with the problems found in every stage and circuit of the receiver. Although experimental point-contact transistors have recently been developed which will provide oscillations for the entire vhf television band, considerable difficulty was found in providing wide-band rf gain using transistors at these frequencies. This problem was much less difficult at intermediate frequencies and at the intercarrier-sound frequency. The second-detector problem of obtaining high rectification efficiency with low load impedances was solved by using a transistor detector. The video amplifier problem was complicated by the requirement for a high input impedance; however, with a combination of junction and contact transistors a stable, high-gain video amplifier with a relatively high input impedance was built. An audio system using complementary symmetrical junction transistors was designed to produce high output with good efficiency.

In the synchronization and deflection portion of the receiver, circuits were devised for using transistors in ways that differ from the analogues of vacuum tubes. A single transistor was used as a dc setter, sync separator, and sync amplifier. A simple and reliable horizontal AFC system was developed by utilizing the symmetrical properties of transistors. Point-contact transistors were found to be particularly economical pulse and sawtooth oscillators. The complementary symmetry principle was used to provide vertical deflection with high linearity and efficiency. In the horizontal deflection circuits the fast high-current switching ability of transistors was used advantageously.

I. INTRODUCTION

AFTER THE DISCOVERY and a study of the symmetrical properties of junction transistors, several circuits were developed which are particularly useful in television systems.[1] Parallel with this development some experience was obtained with point contact transistors both in pulse and vhf circuits, experience which appeared to be useful in television circuitry. In view of these encouraging tests, it was decided to make a general study of transistors in television receivers. For this purpose the construction of a transistorized, portable television set was undertaken.

The first part of this report treats the signal channel consisting of the rf conversion, the intermediate frequency amplifiers, the second detector, the sound channel, and the video amplifier. The second part treats the scanning channel consisting of the synchronizing and deflection circuits, and the high voltage generator. A block diagram of the receiver is shown in Fig. 1 for reference. The choice of this arrangement, the problems, and the final circuit of each block is described in the following sections.

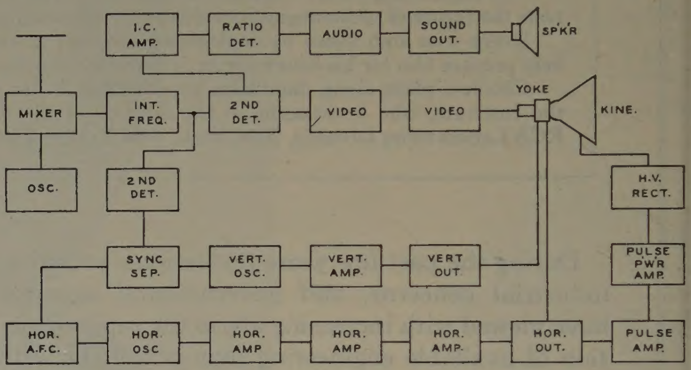


Fig. 1—Block diagram of an experimental transistorized television receiver.

II. TELEVISION SIGNAL CHANNEL

The signal for operation of the receiver is picked up by a loop antenna, mixed with the local oscillator in a pair of crystal diodes, and the resulting difference signal amplified by six stages of grounded-base point-contact transistors. Two second detectors provide independent signals for the sync and video amplifiers. Intercarrier sound from the video second detector is amplified by four inter-carrier frequency stages and demodulated by a ratio detector. The resulting audio signal is applied to an emitter-follower stage driving a complementary type push-pull output stage.[1]

The video signal is amplified by a system combining the higher input impedance of a grounded emitter junction transistor with the high frequency response of a point-contact type.

A loop antenna was decided upon after comparing various antenna types which could be included in a case 12×13×7 inches. Although the tuned loop antenna gives only ¼ the signal power of a full size dipole cut to channel 4, its adaptability to the case, making the receiver completely self-contained, seemed more important. Additional signal can be obtained by coupling an external antenna to the input circuit. The size of the loop antenna was dictated by the outside dimensions of the receiver case. Constructed of sheet brass strips bent to a right angle, the loop fits the top outside edges of the case. Though an effort was made to keep the inductance of the loop low by the right angle construction, its inductance measured at 25 mc was one μh, which requires only 6 $\mu\mu$f to resonate at 68 mc. The tuning capacity is located at a break in the loop at the middle of the front side. Because the loop inductance was too high, and also to provide a means of impedance matching to the mixer diodes, a coil is used in shunt with the loop and tuning capacity. The combination of the loop and coil have an inductance of approximately one-half μh, allowing a larger minimum tuning capacity. Optimum power transfer to the mixer diodes is achieved by connecting the diodes to balanced taps at an intermediate impedance point on the coil.

---

* Decimal classification: R282.12×R583.5. Original manuscript received by the Institute, February 17, 1953.

† Radio Corporation of America, RCA Laboratories, Princeton, N. J.

[1] G. C. Sziklai, "Symmetrical Properties of Transistors and Their Application," PROC. I.R.E., p. 717; this issue.

The local oscillator employs a type TA-172 developmental point-contact transistor designed for high-frequency oscillator use.[2] A suitable oscillator circuit arrangement provides a signal at 60 mc for mixing with the channel four carrier of 67.25 mc. The local oscillator signal is coupled to the midpoint of the loop by a two-turn pickup coil wound over the oscillator tank. A one-volt signal has been measured across this pickup coil when feeding the loop and mixer circuit.

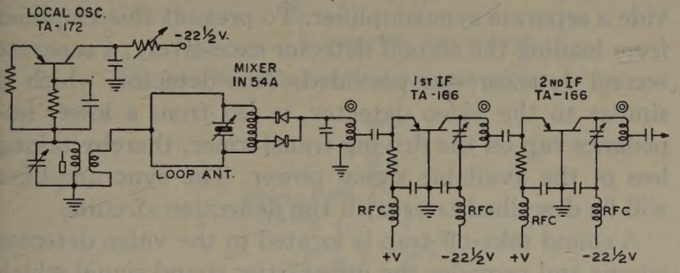


Fig. 2—Schematic of local oscillator, mixer, and first IF amplifier.

The mixer circuit consists of two 1N54A crystal diodes in a balanced arrangement as shown in Fig. 2. The difference frequency is impedance-matched to the first IF amplifier by a tuned circuit which has a tapped coil. This 50-μh coil is wound on a ferrite toroid. By the use of the ferrite toroids for all coils in the tuned IF stages, the effect of stray magnetic fields is reduced and shielding problems minimized. Large impedance transformation ratios are easily obtained because of the high coupling coefficient obtainable. With a total diode mixer current of one ma the mixer circuit gain is -6 db or a two-to-one loss of signal voltage.

For the sake of simplicity the IF amplifiers are stagger tuned. Each of the IF amplifier stages consists of a developmental point-contact transistor, type TA-166, operated in a grounded-base circuit. The collector of one stage is matched to the succeeding stage by a tapped coil similar to that previously mentioned. Collector voltage is supplied by a $22\frac{1}{2}$ volt battery common to the entire receiver but decoupled by an LC filter in each collector circuit. No attempt was made to keep the impedance of the collector circuit high outside of the bandpass as the type TA-166 transistors are short-circuit stable. The emitter bias was fixed at approximately one ma and supplied by a penlite cell battery. The photograph of a part of the IF amplifier, Fig. 3, shows the ferrite toroids used in the interstage tuned circuits.

Over-all power gain of the six stages and the second detector in the band pass shown in Fig. 4 is 47 db. The markers shown are at 5 mc and 10 mc, showing the rising characteristic between 6.5 and 7.5 mc, and the flat top between 7.5 and 9.5 mc.

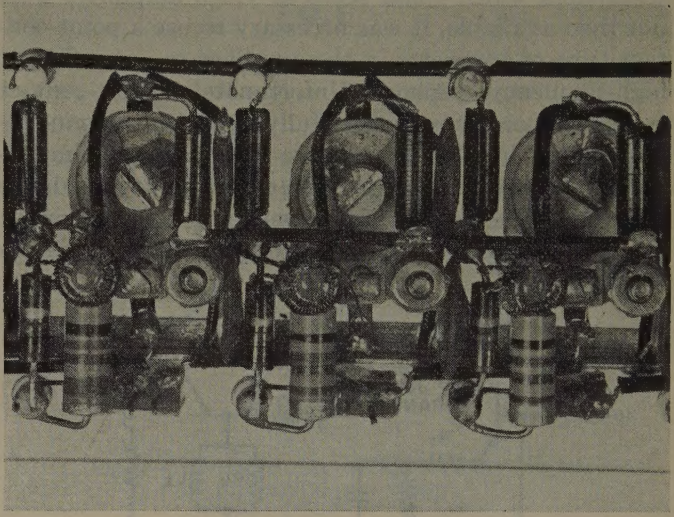


Fig. 3—Close-up of IF strip.

The second detector presented a problem because of the relatively low input impedance of the video amplifier. The first proposal was a crystal detector, but due to the low impedances involved the rectification efficiency was extremely low. Severe negative peak clipping occurred, since the ac load resistance was comparable or even less than the dc load of the crystal rectifier. The logical step was to use a transistor as the detector.

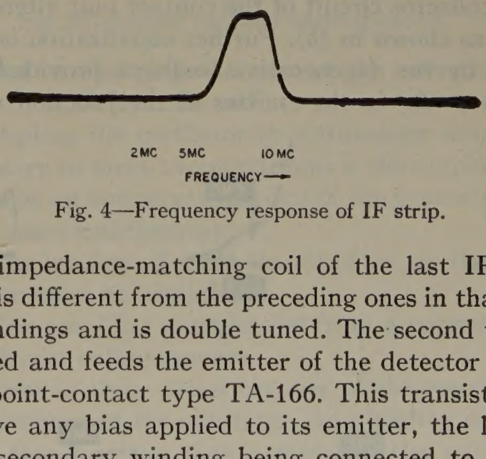


Fig. 4—Frequency response of IF strip.

The impedance-matching coil of the last IF transformer is different from the preceding ones in that it has two windings and is double tuned. The second winding is tapped and feeds the emitter of the detector transistor, a point-contact type TA-166. This transistor does not have any bias applied to its emitter, the low side of the secondary winding being connected to ground. The emitter-base electrodes in the transistor act as a crystal rectifier; the resulting rectified signal appears in the collector circuit amplified by the current gain, alpha, of the transistor.

Since the rectified signal is internally coupled to an amplifying part of the circuit, there is no problem of keeping the dc load resistance small in respect to the ac load. Hence negative peak-clipping problems are avoided and a resulting improvement in rectifier efficiency is obtained. The collector load impedance was kept small to avoid the effects of the frequency dependent input impedance of the video amplifier.

---

[2] B. N. Slade, "The control of frequency response and stability of point-contact transistors," Proc. I.R.E., vol. 40, p. 1382; November, 1952.

The video amplifier was one of the first units of the receiver to be built, and consequently was completed before other parts of the receiver were started. This presented the problem of building an amplifier to work from an unknown source impedance. Since junction transistors which could serve as video amplifiers were not then available, it was necessary to use a point-contact type of transistor in the amplifier to get sufficient high-frequency response. Unfortunately, point-contact transistors are most successfully used in a grounded-base circuit in which they have very low input impedance. To overcome this problem of low input impedance a selected junction transistor was used in a base input circuit so as to drive the emitter of a contact unit as shown in Fig. 5.

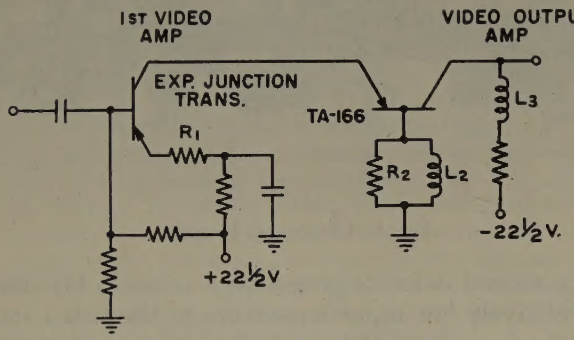


Fig. 5—Video amplifier.

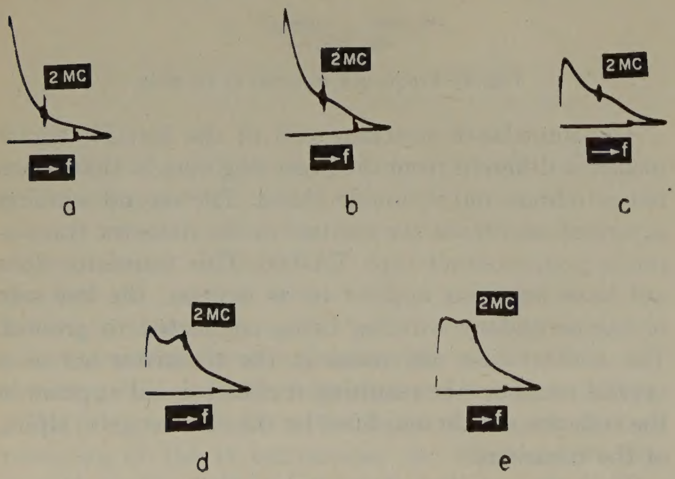


Fig. 6—Frequency response of video amplifier.

The low-frequency voltage gain of the amplifier is 20; the video response is shown in Fig. 6. The response of the basic amplifier with no equalization is shown in (*a*). The addition of a conventional video peaking coil (L_3) in the collector circuit of the contact unit alters the response as shown in (*b*). Further equalization is accomplished by the degenerative feedback provided by the resistance (R_1) in the emitter of the junction unit (*c*). The high output impedance of the junction unit permits the use of positive feedback in the base of the contact unit; the effect of this feedback provided by R_2 and L_2 is shown in (*d*). The result of bypassing R_1 at 1 mc with a low Q series resonant circuit is illustrated in (*e*). In all the figures the marker is at 2 mc and the source impedance of the input signal generator is 1,000 ohms. It is believed that equal or better results can now be obtained by the use of recently developed high-frequency junction transistors in place of the point-contact unit.

The use of a point-contact transistor in the output stage limited the voltage swing obtainable consistent with good frequency response and limited power dissipation. With the 2,700 ohm load resistance used the bias was adjusted to allow an 8 volt peak-to-peak swing in the output, since previous measurements had shown that this value was adequate to provide good picture contrast. However, in later operation of the amplifier it was found desirable to utilize all of this allowable swing for actual picture signal, and consequently the sync pulses were permitted to drive the amplifier into the saturation region and to be lost.

Because of this sync crushing it was necessary to provide a separate sync amplifier. To prevent this amplifier from loading the second detector excessively, a separate second detector was provided. This detector, which is similar to the video detector, is fed from a lower impedance tap on the driving transformer, thereby taking less of the available signal power. The sync amplifier will be described later with the deflection circuits.

A sound take-off trap is located in the video detector circuit and provides the intercarrier sound signal which is amplified by four stages tuned to the intercarrier frequency, 4.5 mc. The first three of these stages are similar to the picture amplifier stages except that they are not stagger tuned, but peaked to 4.5 mc. The fourth stage drives a standard ratio detector transformer modified to operate from a lower source impedance. The demodulator has a peak separation of 120 kc and gives an audio output signal on the order of a volt.

This signal is amplified by a system of unusual design. An emitter follower circuit is used to drive a combination of a *p-n-p* and *n-p-n* transistor in the output circuit. This combination utilizes complementary symmetry properties described in an accompanying paper.[1]

III. The Scanning Channel

The deflection and synchronizing circuits are described in the following sections in the order in which they were developed, rather than in the order shown on the block diagram. By this treatment the reader can appreciate better the choices of the circuits and visualize the way the various circuits took shape.

IV. Vertical Deflection

The equivalent circuit of the vertical yoke consists of a resistance of 65 ohms in series with an inductance of 45 mh. A peak-to-peak current of 100 ma is required to deflect the beam three inches—the proposed picture height. Fig. 7 shows the ideal waveforms necessary to obtain linear deflection.

The waveform to energize the yoke is obtained from a synchronized relaxation oscillator using one TA-165

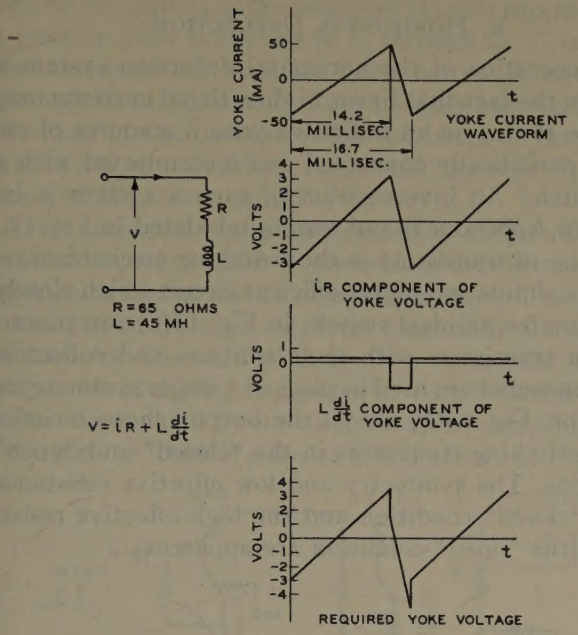


Fig. 7—Theoretical vertical yoke waveforms.

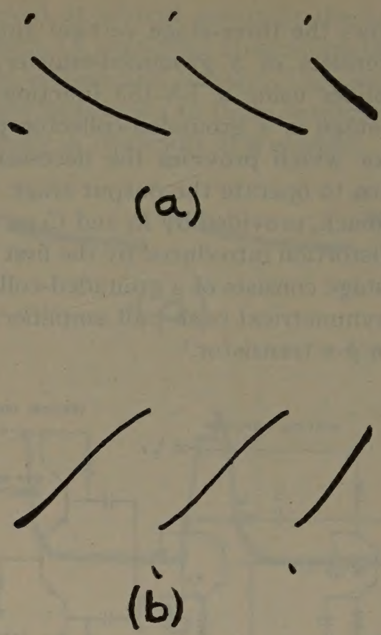


Fig. 9—Waveforms: (a) vertical oscillator output, (b) vertical yoke voltage.

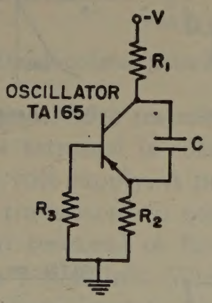


FIG. 8

Fig. 8—Vertical oscillator.

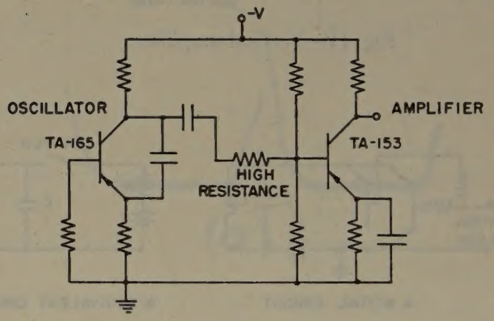


Fig. 10—Vertical oscillator coupling circuit.

point-contact transistor. The operation of this circuit is briefly described by the simplified schematic shown in Fig. 8. The application of voltage causes the base of the transistor to assume a negative potential equal to the product of the base resistor, R_3, and the leakage current across the collector rectifying contact (Appendix A).

The emitter voltage is also negative because of the current which flows through R_2 to charge the capacitor, *C*. As long as the emitter is more negative than the base, the conduction through the emitter-collector path of the transistor is negligible. As the capacitor becomes charged, however, the leakage current increases while the charging current through R_2 falls off exponentially. Eventually a point is reached when the emitter is positive with respect to the base. The capacitor then begins to discharge through the emitter-collector path. Since the current gain of the transistor is greater than unity, the base current increases faster than the emitter current and the action becomes self-sustaining and continues until the capacitor is discharged. The cycle is then repeated. Synchronization is accomplished by applying positive pulses to the emitter at a rate somewhat faster than the free running rate. The voltage waveform across R_1 is shown in Fig. 9(a). The ratio of sawtooth to pulse may be altered by changing the ratio of the collector resistance to the emitter resistance.

In coupling the oscillator to a transistor amplifier it is necessary to meet two conditions if the amplifier output is to be an undistorted replica of the generated wave form. These conditions are:

(1) The loading effect of the amplifier on the oscillator must be negligible.

(2) The amplifier must be fed from a current rather than a voltage source.

The first of these arises because of the reactive output impedance of the oscillator. Any loading of the oscillator therefore not only attenuates the output but also alters the shape of the waveform. The second condition is imposed because of the nonlinear input impedance of the transistor amplifier. Equal increments of collector current are generated by equal increments of base current, which, because of the nonlinear input impedance of the transistor, do not correspond to equal increments in base voltage.

The two conditions are met by using high-resistance coupling as shown in Fig. 10. This resistance prevents loading of the oscillator and at the same time approximates a constant current source for the amplifier.

Fig. 11 shows the three-stage vertical amplifier. The first stage consists of a grounded-emitter, stabilized Class A amplifier using a TA-153 junction transistor. The second stage is a grounded-collector power-junction transistor which provides the necessary drive at low impedance to operate the output stage. Frequency selective feedback, provided by R_1 and C_1 serves to compensate for distortion introduced by the first two stages. The output stage consists of a grounded-collector, complementary symmetrical push-pull amplifier using both a *p-n-p* and *n-p-n* transistor.[1]

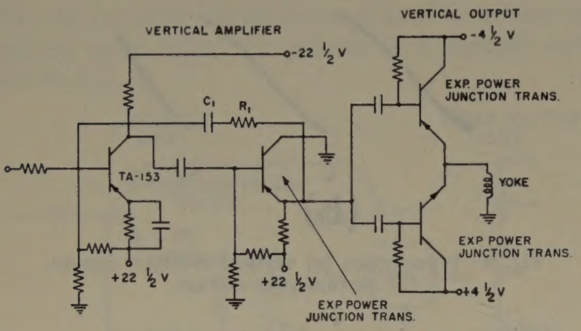
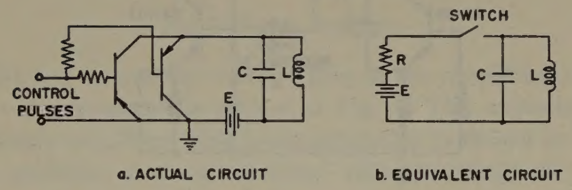


Fig. 11—Vertical amplifier.



a. ACTUAL CIRCUIT

b. EQUIVALENT CIRCUIT

10308

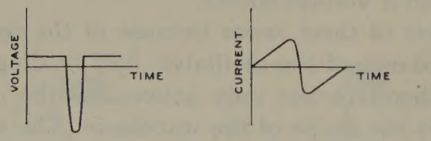
(d) DESIGN EQUATIONS:

$$E = \frac{E_{T\,MAX}}{1 + \frac{\pi(1-\delta)}{2\delta}}$$

$$L = \left(\frac{K(1-\delta)E}{Dfa}\right)^2$$

$$I_{PP} = \frac{f_R D^2}{K^2 E(1-\delta)}$$

$$\sqrt{LC} = \frac{\delta}{\pi f_R}$$



YOKE WAVEFORMS

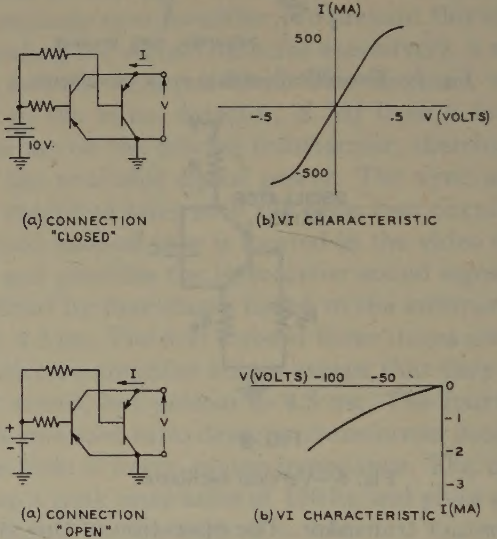
Fig. 12—Horizontal deflection design equations.

The unique properties found in this type of amplifier permit direct coupling to the vertical yoke without the presence of decentering current. The Class A efficiency obtained with this circuit was 24 per cent, which compares favorably with the maximum theoretically possible value of 33 per cent (for a sawtooth wave). The voltage waveform across the yoke is shown in Fig. 9(b).

V. HORIZONTAL DEFLECTION

The operation of the horizontal deflection system is based on the fact that linear bi-directional currents may be made to flow in an inductive yoke if a source of energy is periodically connected and disconnected with a fast switch.[1] An investigation of such a system is included in Appendix B and results tabulated in Fig. 12.

The use of transistors as the switching mechanism results in a simple and highly efficient circuit which closely approximates an ideal switch. In Fig. 13(a) two power-junction transistors with their emitters and collectors cross-connected are used in place of a single symmetrical transistor. Fig. 13(b) shows the output characteristics of the switching transistors in the "closed" and "open" conditions. The symmetry and low effective resistance of the "closed" condition and the high effective resistance of the "open" condition are apparent.



(a) CONNECTION "CLOSED"

(b) VI CHARACTERISTIC

(a) CONNECTION "OPEN"

(b) VI CHARACTERISTIC

Fig. 13—Output characteristics of switching transistors.

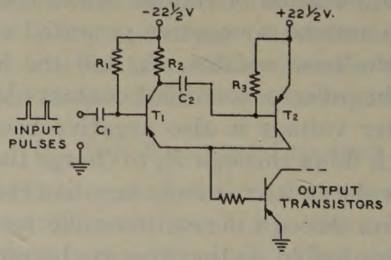


Fig. 14—Totem pole circuit.

In order to control the output transistors it is necessary that their bases be returned to a source of negative potential while they are conducting, and to a source of positive potential while they are cut off. This is accomplished with another form of switching circuit employing two transistors as shown in Fig. 14. The arrangement, essentially a single-pole double-throw switch, has come to be known as the "totem pole" circuit.

During the forward trace of the beam the first transistor, T_1, is in a high conduction state because of the large negative bias applied through R_1, while T_2 is cut off. The bases of the output transistors are thus connected through T_1 to the negative $22\frac{1}{2}$ volt supply. When a positive pulse is applied to T_1 through C_1, T_1 is cut off and the resulting negative pulse across R_2 is coupled through C_2 to T_2, causing T_2 to conduct heavily. For the duration of the positive pulse the bases of the output transistors are therefore connected through T_2 to the positive $22\frac{1}{2}$ volt supply.

This indicates that pulses occurring at line repetition rate and equal in width to the retrace time are necessary to operate the horizontal deflection system. These pulses are obtained from an oscillator essentially the same as is used for the vertical deflection, except for the frequency-determining components. Amplification of the pulses is provided by the direct-coupled complementary symmetrical Class B pulse amplifier shown in Fig. 15.

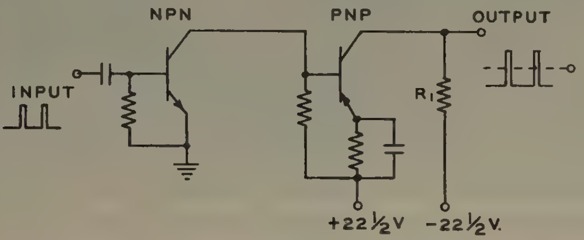


Fig. 15—Direct-coupled pulse amplifier.

With no input signal, both transistors are nearly cut off, and the output terminal is connected through R_2 to the negative $22\frac{1}{2}$ volt supply. A positive pulse at the input causes both transistors to conduct heavily and connects the output terminal to the positive $22\frac{1}{2}$ volt supply through the *p-n-p* unit. With this circuit it is possible to obtain approximately 40 volt peak-to-peak output pulses from a peak-to-peak input of 0.5 volt.

The preceding discussion has tacitly assumed that the elapsed time between the oscillator discharge and the opening of the switching transistors is negligible when compared to the time for one line retrace. If this were true, driven sync could be used. However, because of reactive effects associated with the input circuit of the switching transistors, there is appreciable time delay between the application of a positive pulse and the "opening" of the yoke circuit. Experimentally it was found that this delay is approximately 15 μsec, which is about 5 μsec longer than the time allotted for horizontal retrace in the video signal.

One effect of such a delay on the television picture is to place a black vertical bar at the right of the screen which corresponds to the horizontal blanking in the video signal. In addition, a portion of the "left-hand" side of the picture appears immediately to the right of the black bar. Finally, the beam is not blanked during retrace and thus tends to smear that portion of the picture which does appear.

It is apparent that an afc system can compensate for this delay by re-phasing the horizontal oscillator. A simple and reliable transistor afc system will be described in a later section.

Figs. 16, 17, and 18 show photographs of the waveforms observed at several points in the horizontal deflection system. Of particular interest are those concerning the yoke voltage and current. The similarity of the photographed waveforms to those predicted by the elementary theory in Appendix B is evident.

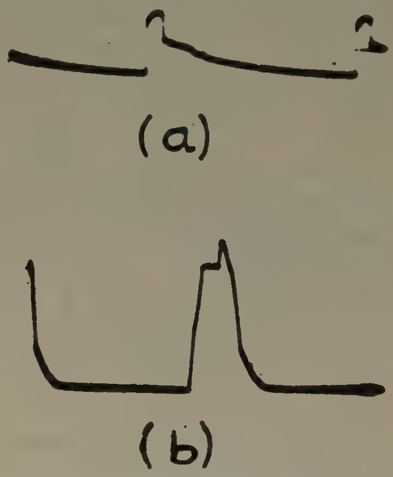


Fig. 16—Waveforms: (a) horizontal oscillator output, (b) input to totem pole circuit.

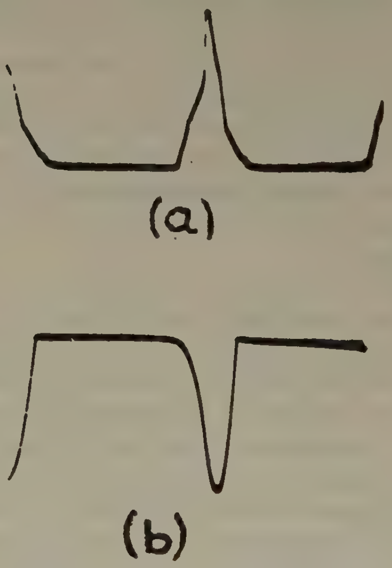


Fig 17—Waveforms: (a) output of totem pole circuit, (b) yoke volta

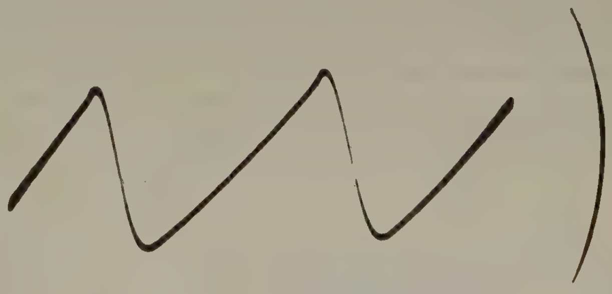


Fig. 18—Horizontal yoke current waveform.

VI. Sync Channel

A schematic of the synchronizing circuits of the receiver is shown in Fig. 19. The sync separator and amplifier consists of two TA-153 junction transistors. The first of these is connected grounded base. The emitter-base rectifier serves to separate the sync pulses which are coupled by the collector circuit to the following amplifier. After integration, the vertical pulses are amplified by one more grounded emitter stage and are then used to synchronize the vertical oscillator.

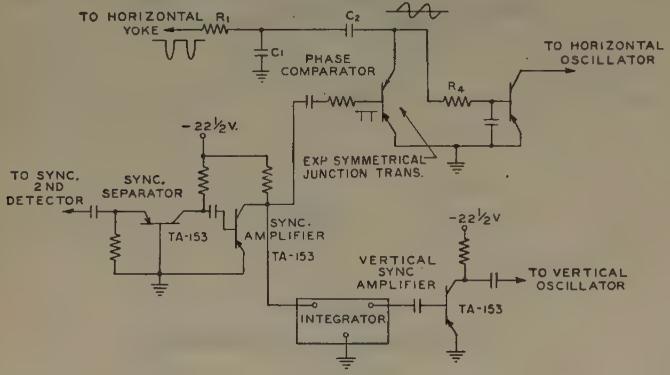


Fig. 19—Sync channel and afc circuits.

The horizontal afc system mentioned previously depends for its operation on the symmetrical properties of the phase comparator transistor. The retrace voltage pulse from the deflection yoke is integrated by a network consisting of R_1 and C_1. In the absence of a negative sync pulse on its base, the phase comparator functions simply as a high-resistance and the integrated retrace pulse appears as a symmetrical sawtooth wave, its dc component having been removed by C_2. There is therefore no dc voltage on the base of the frequency-control transistor.

The operation is unchanged if the horizontal sync pulse arrives coincident with the time of zero voltage during the sawtooth retrace. If the sync pulse arrives when the retrace voltage is positive C_2 receives an incremental charge through the resulting low resistance of the phase comparator. During the time before the next sync pulse, this incremental charge drains off through R_4 and the frequency-control transistor. A small negative bias is thus generated on the base of the frequency-control transistor which lowers its effective resistance and causes the horizontal oscillator to fire sooner than on the previous cycle. The action continues until the sync pulse occurs simultaneously with the zero-voltage point of the sawtooth retrace. The sequence of operation is reversed in the event the sync pulse originally arrives while the sawtooth retrace is negative.

VII. High-Voltage Supply

Because the flyback voltage of the horizontal deflection system is limited by the transistors, and since no transformer is used, it is not convenient to get the 2,000 volts dc for the kinescope directly from the deflection system. For this reason a separate system shown in Fig. 20 was used. This is essentially a two-stage Class B amplifier driving a tuned transformer in the output. The negative flyback pulse is lightly coupled to the amplifier and causes the first transistor to conduct, thereby applying a conduction bias to the output stage. The output transistor, a power type, conducts heavily and supplies power to the tuned transformer at a horizontal frequency. The choke in the base circuit of the output transistor provides a low-impedance dc path and insures that any leakage current in either transistor does not bias the output to conduction except when the system is pulsed. A half-wave selenium rectifier and filter provide the 2,000 volts dc from the secondary of the tuned transformer.

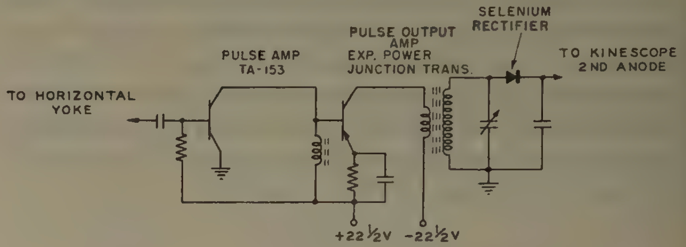


Fig. 20—High-voltage system.

VIII. Over-all Data and Tests

The receiver was built in a portable form with self-contained batteries in a clear plastic case. The total power consumption of the receiver is 13 watts. Of these 13 watts, 3.6 watts, or more than 25 per cent, go into the filament of the kinescope. The kinescope is the 5FP4 type and provides a 3×4-inch picture with a highlight brightness of approximately 10 foot lamberts.

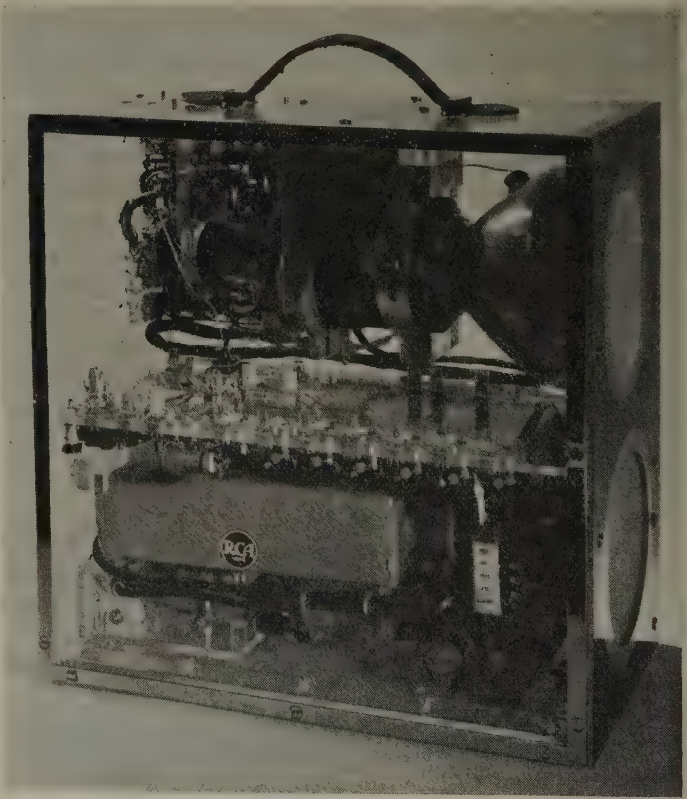


Fig. 21—General layout of receiver.

The general layout of the receiver is shown in Fig. 21. The signal channel is built on the vertical plastic shelf in the center of the receiver. The deflection chassis is under the neck and the socket of the kinescope. The high-voltage supply is placed beyond the batteries to provide the least disturbance to the rest of the receiver. Fig. 22 shows the receiver in its normal viewing position. Total weight of receiver with batteries is 27 lbs.

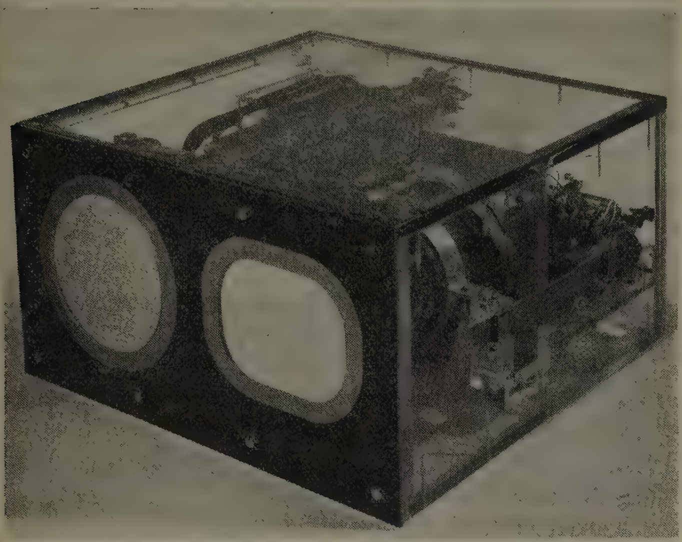


Fig. 22—Front view of receiver.

The receiver was tested in the north Jersey area and satisfactory reception was obtained with the built-in loop within an area of approximately five miles radius from WNBT. With the aid of a simple dipole held by hand about seven feet from the ground, satisfactory reception was obtained out to Elizabeth, N. J. about 15 miles away from the Empire State Building. The receiver was also demonstrated on many occasions from a reradiated signal of approximately 5 mv/meter in Princeton, N. J. This sensitivity was not limited by noise and could be increased substantially with additional stages or improved transistors, which are available at the present writing.

ACKNOWLEDGMENT

The authors wish to acknowledge the interest and encouragement of V. K. Zworykin, I. Wolff and R. D. Kell; the suggestions of W. J. Howarth, who wired and assembled the receiver; and R. C. Ballard, who made circuit tests.

APPENDIX A

With reference to Fig. 8:

$$V_b = -I_{c0}R_3,$$

$$V_e = -\frac{VR_2}{R_1 + R_2}\exp -\frac{t}{(R_1 + R_2)C}.$$

The condition for negligible emitter-collector conduction is:

$$|V_b| < |V_e|.$$

When this condition is no longer met, the discharge begins and is cumulative since:

$$I_b = I_{c0} + I_E(\alpha - 1).$$

$$\alpha > 1.$$

APPENDIX B

Horizontal Deflection System

The operation of the horizontal deflection will be described by assuming:

(1) that the yoke is a perfect inductance, and

(2) that the transistor is a bi-directional switch with a constant resistance when closed and infinite resistance when open.

The circuit operation will be considered during three durations of time:

(1) T_1, during which the switch is closed;

(2) T_2, during which the switch is open;

(3) T_3, during which the switch is closed;

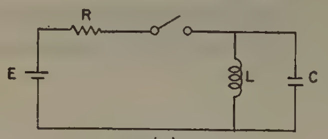
The relationships between these time durations are:

$$T_1 = T_3, \tag{1}$$

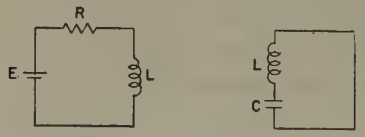
$$\frac{T_2}{T_1 + T_2 + T_3} = \delta, \tag{2}$$

$$T_1 + T_2 + T_3 = \frac{1}{f_R}, \tag{3}$$

where δ is the ratio of the retrace time to the time for one complete cycle, and f_R is the line repetition rate.



(a)
SIMPLIFIED EQUIVALENT CIRCUIT



(b)
CIRCUIT DURING T_1 AND T_3

(c)
CIRCUIT DURING T_2

Fig. 23—Circuits of Appendix B analysis.

The simplified circuit is shown in Fig. 23(a).

The circuit may be further simplified as shown in Fig. 23(b), (c) for each of the three time intervals if the additional assumption is made

$$RC \ll T_1. \tag{4}$$

The operation during the interval T_1 (Fig. 23(b)) is

$$I(t)R + L\frac{dI(t)}{dt} = E, \tag{5}$$

$$I(0) = 0. \tag{6}$$

The solution is

$$I(t) = \frac{E}{R}(1 - e^{-tR/L}), \tag{7}$$

$$I(t) = \frac{E}{L}t; \tag{8}$$

where the assumption that $L/R \gg t$, $0 \leqq t \leqq T_1$ has been made.

The operation during T_2 while the switch is open is as follows (Fig. 23c):

$$L\frac{dI(dt)}{dt} + \frac{1}{C}\int I(t)dt = 0, \tag{9}$$

$$I(0) = \frac{E}{L}T_1. \tag{10}$$

The solution is

$$I(t) = \frac{E}{L}T_1 \cos t/\sqrt{LC}, \tag{11}$$

where time is measured from the instant of opening the switch. If the switch remains open for a time such that

$$\frac{t}{\sqrt{LC}} = \pi = \frac{T_2}{\sqrt{LC}}, \tag{12}$$

then

$$T_2 = \pi\sqrt{LC}\,\cdot \tag{13}$$

Thus, at the end of T_2 the current in the yoke has reversed and the resonant circuit has gone through one-half cycle of oscillation. The operation during T_3 is as follows (Fig. 23(b))

$$RI(t) + L\frac{dI(t)}{dt} = E, \tag{14}$$

$$I(0) = -\frac{E}{L}T_1. \tag{15}$$

The solution in this case is

$$I(t) = \frac{E}{L}t - \frac{E}{L}T_1 + \frac{RE}{L^2}T_1 t \tag{16}$$

$$I(t) = \frac{E}{L}t\left(1 + \frac{T_1}{L/R}\right) - \frac{E}{L}T_1,$$

$$I(t) = \frac{E}{L}t - \frac{E}{L}T_1; \tag{17}$$

since the assumption that $L/R \gg T_1$ has already been made. The current during T_3 is therefore a linear time function minus a constant current. At the end of T_3 the linear term equals the constant term and the current is zero. The cycle then repeats.

It is desirable to eliminate the three intervals of time T_1, T_2 and T_3 from the equations since they can be expressed in terms of L, C, δ, and f_R. This may be done as follows. From (13), (2), and (3):

$$T_2 = \pi\sqrt{LC}, \tag{18}$$

$$T_1 = \frac{T_2(1-\delta)}{2\delta} = \frac{\pi\sqrt{LC}\,(1-\delta)}{2\delta} = T_3, \tag{19}$$

$$\sqrt{LC} = \frac{\delta}{\pi f_R}\,\cdot \tag{20}$$

The idealized waveforms for the complete cycle are shown in Fig. 12.

In designing the horizontal deflection system it is necessary to derive several relationships which connect the magnitude of the deflection span to the equations determined in the previous discussion. The solution is somewhat inflexible because of the limited voltage rating of the switching transistors, the particular yoke and kinescope construction used, and the anode voltage chosen for the kinescope. Let

K = a measurable constant depending on yoke construction and anode voltage,
D = deflection width in inches,
δ = ratio of retrace time to the time for one complete cycle,
L = inductance of yoke in henries,
f_R = line repetition rate in cps,
E = battery voltage in volts, and
I_{pp} = peak-to-peak deflection current in amperes.

It can be shown that

$$I_{pp} = \frac{D}{K\sqrt{L}} = \frac{E}{L}(T_1 + T_3). \tag{21}$$

From (1) and (19)

$$T_1 + T_3 = 2T_1 = \frac{\pi\sqrt{LC}\,(1-\delta)}{\delta}\,\cdot \tag{22}$$

From (20)

$$\sqrt{LC} = \frac{\delta}{\pi f_R}\,\cdot \tag{20}$$

Therefore

$$L = \left[\frac{K(1-\delta)E}{Df_R}\right]^2, \tag{23}$$

$$I_{pp} = \frac{f_R D^2}{K^2 E(1-\delta)}\,. \tag{24}$$

For a given deflection width, repetition rate, yoke construction, kinescope construction, and anode voltage, it is seen that both L and I_{pp} are dependent only on E and δ. With the transistors used, E is uniquely determined by δ and the maximum allowable voltage across the transistors.

The maximum voltage across the yoke inductance may be found from (11).

$$I_L = \frac{E}{L}T_1 \cos t/\sqrt{LC}, \tag{11}$$

$$E_L = L\frac{dIL}{dt} = -\frac{E\pi(1-\delta)}{2\delta}\cdot \sin t/\sqrt{LC}. \tag{25}$$

This expression is a maximum when:

$$\sin t/\sqrt{LC} = 1.$$

Therefore,

$$E_{LMAX} = \frac{-\pi(1-\delta)E}{2\delta}. \qquad (26)$$

Maximum voltage across the transistors, E_{TMAX}, is

$$E_{TMAX} = E_{LMAX} + E, \qquad (27)$$

where the signs must be chosen so the voltages add

$$E_{TMAX} = -E\left[1 + \frac{\pi(1-\delta)}{2\delta}\right]. \qquad (28)$$

* * *

Symmetrical Properties of Transistors and Their Applications*

GEORGE CLIFFORD SZIKLAI†, SENIOR MEMBER, IRE

Summary—**Transistors have certain characteristics which are not present in vacuum tubes. Some of these characteristics may be best classified as symmetrical properties. The first kind of symmetry may be found in the complementary characteristics of the *n-p-n* and *p-n-p* transistors. Circuits using both kinds of transistors in combination provide unique advantages in reduction of components and other circuit simplifications.**

A second kind of symmetry is displayed by single units since the emitter and collector may be interchanged. This symmetry permits a current flow of either direction controlled alike by the base current. This basic property is useful in switching circuits for clamping, phase and frequency comparison, modulation, and so forth. A high efficiency deflection-current circuit for television was developed using this principle.

I. INTRODUCTION

A TRANSISTOR CIRCUIT, approached from the point of view of small-signal analysis, is usually found to be an analogue of some vacuum-tube curcuit. As a consequence a transistor circuit may be found for most vacuum-tube circuits by means of duality and analogue synthesis. However junction transistors have certain properties which are not available in vacuum tubes and which are unique in a number of applications. The purpose of this paper is to present a group of these unique properties and discuss some of their applications.

II. COMPLEMENTARY SYMMETRY

One unique property of the junction transistors is that there are two basic kinds: *n-p-n* and *p-n-p* units. One is the symmetrical counterpart of the other, as a hypothetical positron tube would form the counterpart of the conventional electron tube. A very accurate name for this property may be borrowed from the language of crystallography, called "enantiomorphy" defined by the Webster New International Dictionary as: "alike but not superposable; related to each other as a right handed to a left handed glove." It is felt, however, that the term complementary symmetry would gain wider acceptance.

A typical static characteristic curve of either type of transistor is shown in Fig. 1. The top signs apply to an *n-p-n* transistor, while the bottom signs correspond to its *p-n-p* counterpart. The abscissa is the potential drop between the emitter and the collector (E_c), and the ordinate is the collector current (I_c) for a family of base currents (I_b). A more correct, if more elaborate presentation, would be provided by eliminating alternate signs and showing characteristics of the *p-n-p* unit in third quadrant of the coordinate system. Either way the odd-function symmetry of the two units is apparent.

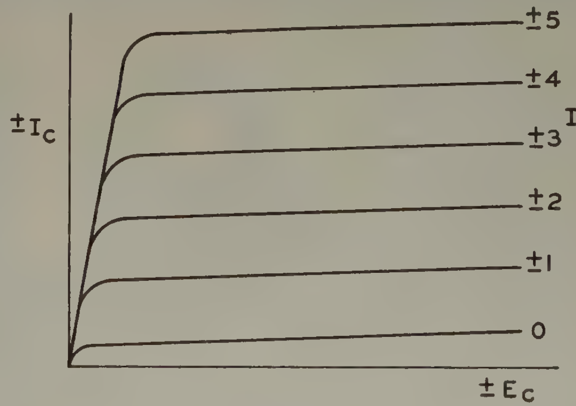


Fig. 1—The characteristics of *n-p-n* or *p-n-p* transistor.

This property can be used in a number of ways. As the base current is changed in the same direction in both units, the emitter-collector current flow will increase in one and decrease in the other. A pair of these units fed from the same signal will, therefore, provide a single-ended push-pull output. Fig. 2 shows such a single-ended push-pull circuit which operates without a transformer or phase inverter. The constants are based on an experimental setup using an RCA developmental *p-n-p* type TA-153 transistor and its *n-p-n* counterpart, experimental type TA-154 transistor.

---

* Decimal classification: R282.12. Original manuscript received by the Institute, February 17, 1953.

† RCA Laboratories, Princeton, N. J.

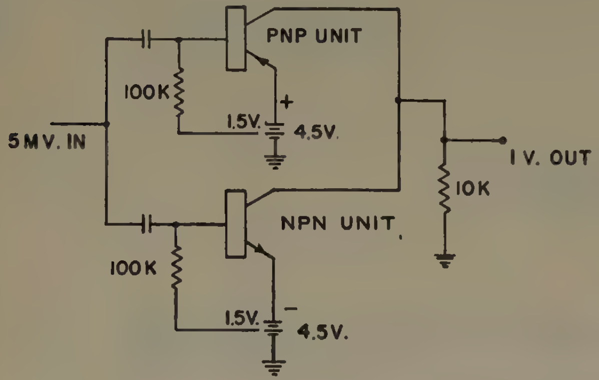
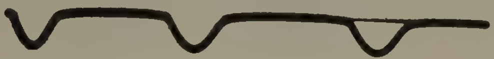
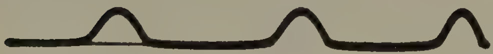


Fig. 2—Push-pull transistor amplifier with complementary symmetry.

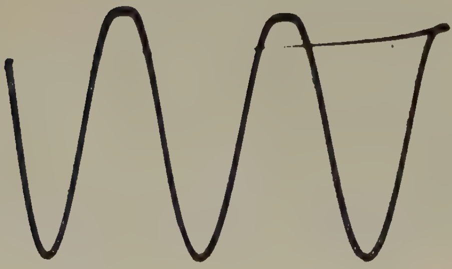
One of the features of this circuit is the position of the power supply, which is connected between the common element of the transistor and ground. As the base current is increased (it is made more negative for the *p-n-p* unit or more positive for the *n-p-n* unit) the resistance between the emitter and the collector is reduced and the potential at the output circuit will approach that of the respective power supplies. Thus if the input swings positive, the resistance of the *n-p-n* unit is reduced, and the top of the load becomes negative since, at the same time, the emitter-collector resistance of the *p-n-p* unit is increased. Similarly a negative-input swing reduces the resistance of the *p-n-p* unit and increases the resistance of the *n-p-n* unit thus making the potential of the load impedance positive. The amplifier, as shown, operates in Class A and provides a gain of 46 db. The waveforms given in Fig. 3 show the output of the individual units with one unit removed and with both units inserted. With both units inserted, the applied voltage is 9V instead of 4.5V; thus the amplifier operates in Class-A mode, and, since one unit acts as the load for the other, the external load impedance may be removed and a high voltage gain can be obtained for a number of special applications.



WAVEFORM WITH THE NPN UNIT ONLY



WAVEFORM WITH THE PNP UNIT ONLY



WAVEFORM WITH BOTH UNITS IN THE CIRCUIT

Fig. 3—The waveforms of the push-pull amplifier.

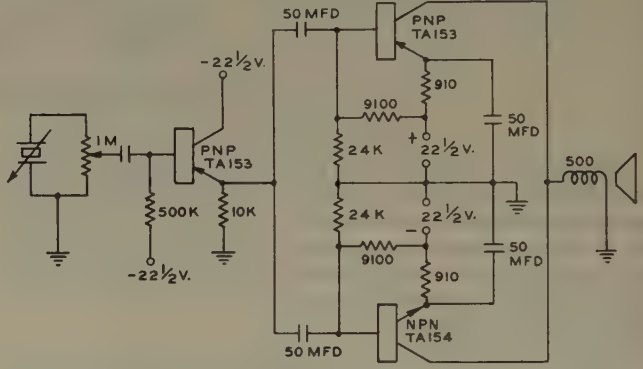


Fig. 4—A Class-A push-pull audio amplifier schematic.

Fig. 4 shows the circuit of a Class-A audio amplifier using two RCA-type TA-153 transistors and an experimental *n-p-n* transistor which provides 100 mw of audio output directly into a 500-ohm voice-coil speaker. The complete experimental amplifier with two 22½ hearing-aid batteries is shown in Fig. 5. The input socket is on the left and the direct output to the loudspeaker voice coil is on the right. The transistor on the extreme right is the TA-154 type *n-p-n* unit similar in appearance and size to the other two type TA-153 *p-n-p* units. A similar Class-A amplifier using RCA experimental *n-p-n* and

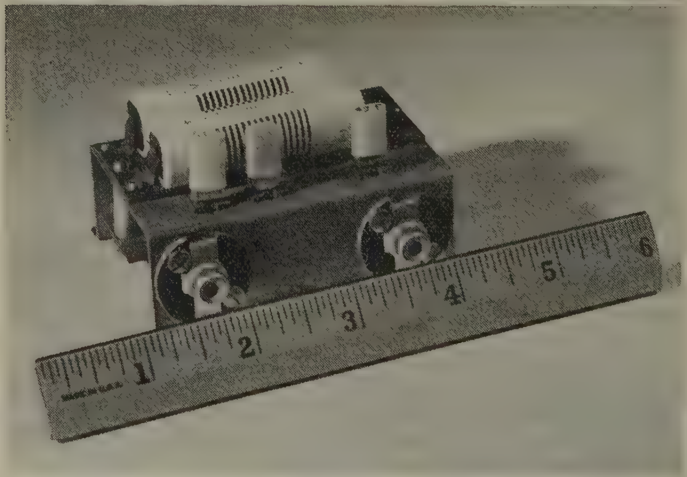


Fig. 5—A 100-mw Class-A push-pull transistor amplifier.

p-n-p power transistors with emitter output provided a 0.65-watt audio output from a 9-volt supply. Since there is no dc flowing through the load, the voice coil is balanced; or there is no decentering if the circuit is used for vertical magnetic-kinescope deflection.

In certain cases it is desirable to use a power supply with as low a voltage as possible, and to realize a large portion of this voltage for the swing across the load. This may be accomplished by splitting the load and applying the potential swing available across each half of the load. By this means the peak-to-peak voltage swing approaches twice the potential of the power supply. The split load as shown in Fig. 6 may represent two primary windings of a transformer, two halves of a deflection yoke or a split-voice coil.

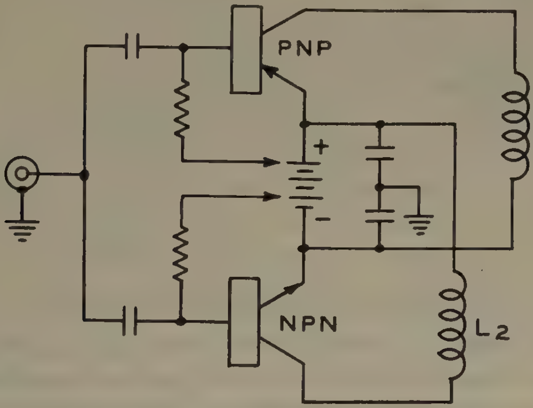


Fig. 6—Push-pull amplifier with split load.

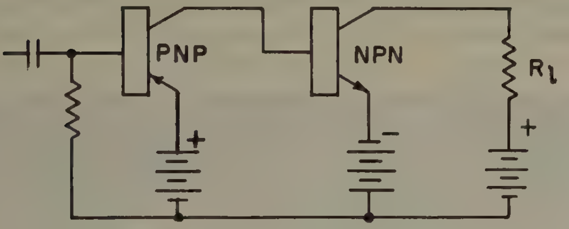


Fig. 7—Direct coupled-transistor amplifier.

Another application of the use of *p-n-p* and *n-p-n* transistors in combination is shown in Fig. 7, in which the two complementary units form a direct-coupled amplifier. The circuit shows only two stages but the chain can be extended by additional cascaded stages using the same power supply. Again the power supply is between the common electrode and ground. Although the circuit provides a slightly lower voltage or current gain than α_{cb} (see appendix), and a considerably lower gain than would be obtainable with matching circuits, it provides a simple dc amplifier with a minimum number of components. Voltage gain in the order of 25 per stage were obtained.

The complementary symmetry of transistors finds an interesting application when it is applied to the cascading of push-pull amplifier stages. This principle is applied in the two-stage direct-coupled Class-B amplifier shown in Fig. 8. This circuit draws negligible current until a signal is applied. Unlike conventional Class-B amplifiers, however, it does not require either an input or output transformer. As may be observed from its circuit diagram, it does not contain any parts other than the transistors themselves when operating from a high-input resistive source directly into a 16-ohm-loudspeaker voice coil. The low-output impedance and the stable operation is made possible by the over-all feedback which extends down to dc. This feedback was suggested by R. D. Lohman. Incidentally this amplifier is a very stable dc amplifier, and it is unique in that it is a zero-center dc amplifier.

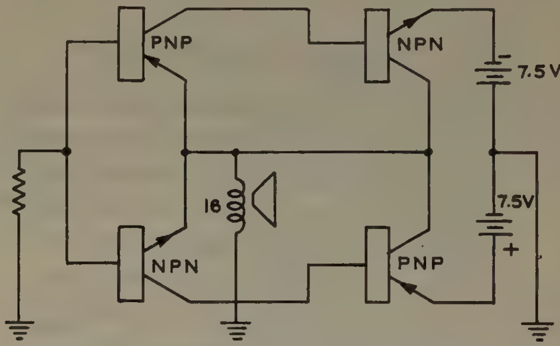


Fig. 8—Schematic of a Class-B push-pull transistor amplifier with complementary symmetry.

The amplifier was built in one form with two TA-153 and two TA-154 units in a small clear plastic case with a four-prong base, as shown in Fig. 9. The four connections correspond to the input, output and the two battery terminals. The TA-153 and TA-154 transistors are normally considered for less than 50-mw applications.

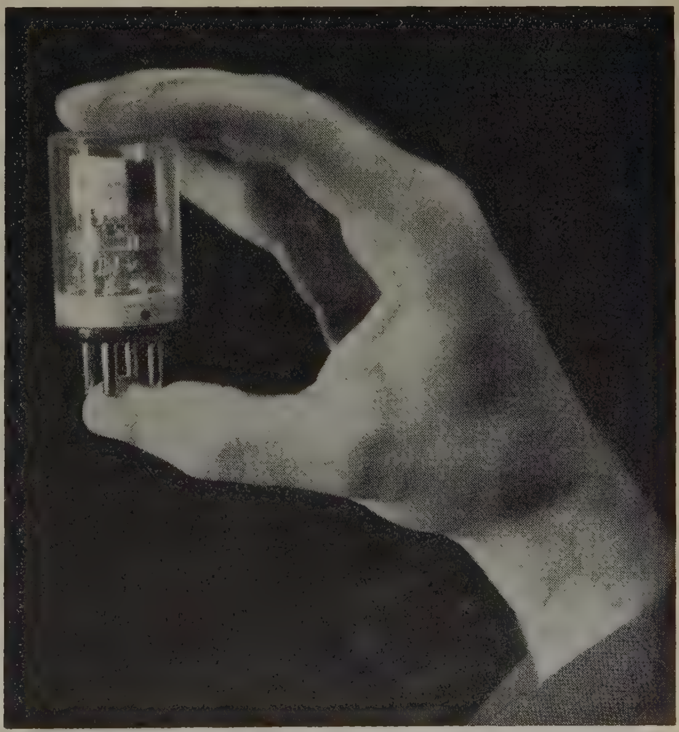


Fig. 9—A half-watt Class-B push-pull transistor amplifier.

In this case, however, a maximum-rms power output of one-half watt was obtained on a short-time basis. Since for speech or music, the average power is 10 db lower than the maximum requirement, and since the amplifier has an over-all efficiency (power output÷total power input for both the driver and the output stage) of 50 per cent at practically all levels, the unit can be used at the maximum rms rating as an audio amplifier. The power gain of the amplifier is approximately 28 db. Due to the feedback, the voltage gain is slightly less than unity. The total distortion at the 0.5 watt level was approximately 2 per cent.

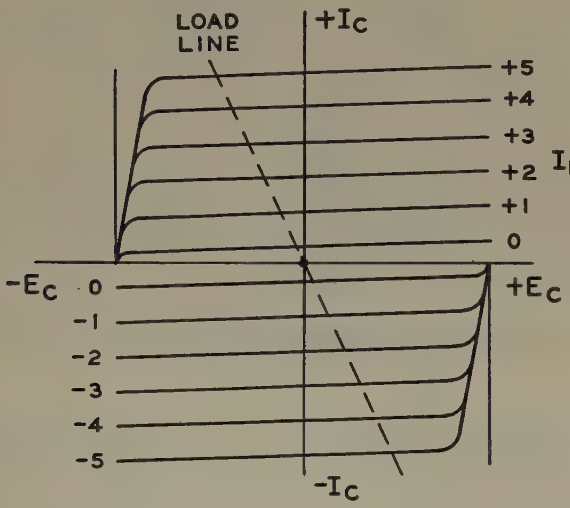


Fig. 10—Load-line construction for transistor push-pull amplifiers.

At this point it may be interesting to consider the operation of a push-pull amplifier using complementary symmetry in light of the family of collector curves and the way the load impedance determines the output characteristics like the maximum power available, the distortion thus expected, and so forth. The first thing that is to be considered is that in all the circuits the power supply is in series between the common electrode and ground. Thus the origin of the output voltage shifts in the positive-current domain to the left and in the negative-current domain to the right as shown in Fig. 10. The shifts correspond to the voltage applied between the common electrode and ground. The load line now may be drawn through the origin with the slope corresponding to the load resistance. From the load intersections with the collector-current curves, the power output and the distortion may be estimated readily. For Class-A operation collector curves should be shifted vertically to make zero-signal currents coincide, and currents of the two transistors should be added.

A number of circuits can be devised to take advantage of the complementary symmetry of *n-p-n* and *p-n-p* transistors to provide certain unique properties such as very low or high output impedances, low impedance frequency compensation, and so on. The circuits described serve merely as illustrations of the principle.

III. SINGLE-UNIT SYMMETRY

Transistors display another type of symmetrical property involving a single unit. This characteristic may be best described by a simple experiment, using the test setup shown in Fig. 11. A collector voltage with either polarity can be applied through a double-pole double-throw switch and similarly the potential applied to the base can be varied continuously with either polarity.

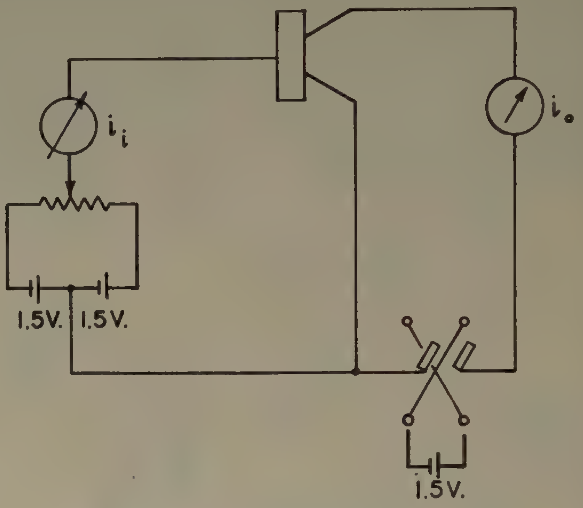


Fig. 11—Test setup to check transistor symmetry.

The results of such a test are shown in Fig. 12. The current flowing in the base circuit is shown on the abscissa and the emitter-collector current is shown as the ordinate. When a *p-n-p* transistor is tested it is found that some emitter-collector current flows in either direction as long as negative bias is applied to the base. The extent of the negative-emitter current may vary from unit to unit; however it is present in most cases.

There is no comparable action in vacuum tubes since this would require an anode emitting electrons and a

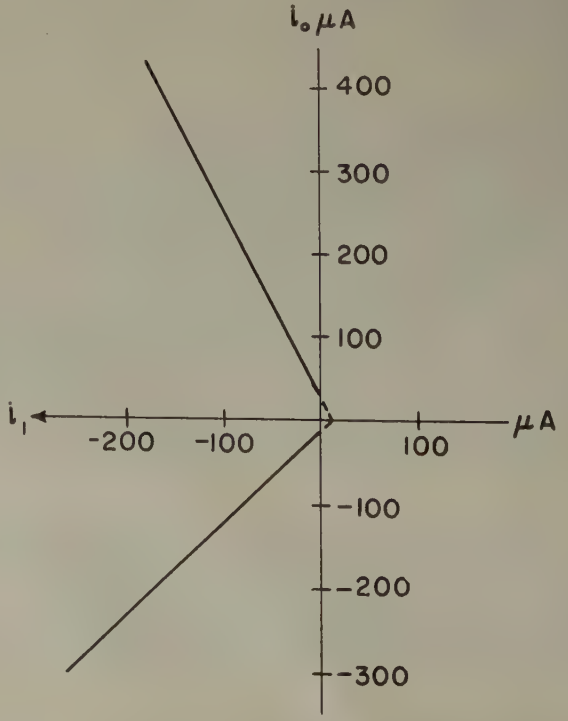


Fig. 12—Collector current symmetry in special transistors.

thermionic cathode accepting them. With transistors however, a reference to the energy level diagram in Fig. 13 clearly shows that units with high degree of symmetry can be constructed. This is particularly true for the alloying process of transistor making.

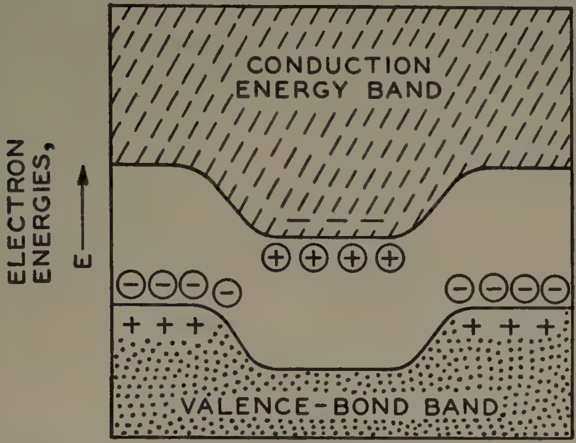
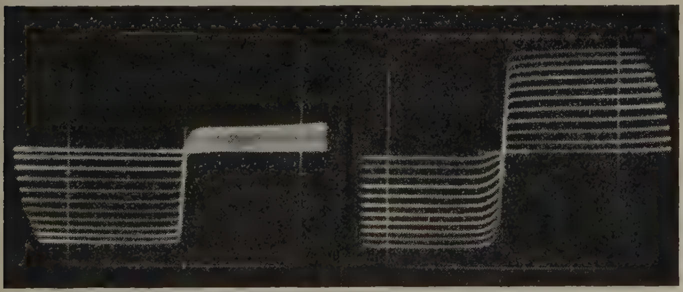


Fig. 13—The energy-level diagram of a junction transistor.

In Fig. 14 there are two examples showing the variation that can be obtained with the alloying technique with respect to the single-unit symmetry. The curves are of the collector voltage and current family of two units, with Fig. 14(a) showing the curves of a unit made deliberately non-symmetrical, and 14(b) representing a symmetrical unit. In both cases the abscissa represents the collector voltage, the ordinate the collector current, and the curves depart further from the origin as the base currents are increased. These curves display an odd-function symmetry similar to that displayed by the complementary symmetry. They were taken on the transistor curve tracer[1] by G. B. Herzog.



(a) (b)

Fig. 14 (a) and (b)—Collector current family curves for asymmetrical and symmetrical transistors.

The single-unit symmetry has many interesting applications since it provides a fast bi-directional switch. The author has pointed out before, that a bi-directional switch can provide a sawtooth current with very high efficiency.[2] A single symmetrical transistor can provide this function with a minimum number of circuit components and with an efficiency considerably surpassing tube circuits. The operation of the circuit will be described briefly here in order to indicate the available efficiency. It is described, however, in greater detail in the accompanying paper on transistors in television circuits with reference to design and construction.[3]

The basic deflection circuit is shown in Fig. 15. When the base is biased negatively, the emitter-collector circuit is closed, and the current increases linearly in time according to the relation

$$\frac{di}{dt} = \frac{E_B}{L}.$$

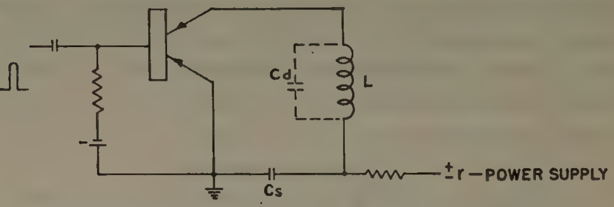


Fig. 15—Switching circuit for horizontal deflection.

At some time the positive pulse opens the circuit and the energy stored in the inductance will be discharged through C_d in an oscillatory manner according to

$$L\frac{di}{dt} + \frac{I}{C_d}\int idt = 0$$

$$\therefore \quad i = \frac{E_B}{\sqrt{L/C_d}} \cos \frac{t}{\sqrt{LC_d}}.$$

If the transistor is made to be conductive again at $t - \sqrt{LC_D}$ (in other words at the half period of the natural frequency of the yoke circuit), the energy is returned into the power supply C_S through reverse path of transistor. Current will change again in a linear manner until it drops to zero, when cycle starts again.

The deflection circuit however has some resistance and the current actually follows the equations

$$iR + L\frac{di}{dt} = E_B$$

$$\therefore \quad i = \frac{E_B}{R}\left(1 - E^{\frac{R}{L}t}\right).$$

This relationship suggests that a correcting input signal, which consists of a sawtooth as well as of a pulse, has to be applied to the base of the switching transistor, and iR losses must be replaced by current supply.

IV. THE POWER FACTOR CONCEPT IN HORIZONTAL DEFLECTION CIRCUITS

The current and voltage waveforms in a resistanceless yoke are shown in Fig. 16. The voltage curve is simply the derivative of the current wave. Since the maximum voltage occurs when there is no current, the analogy to out-of-phase loads on sine-wave currents suggests itself readily. In the case of a predominantly reactive load, the ratio of the actual power taken from the source to the volt-amperes developed (in other words the power factor), turned out to be a useful concept. In the case of the horizontal-deflection circuit the same concept is very useful for the comparison and evaluation of different arrangements. Since neither the input nor the output currents are sinusoidal some reconsiderations are necessary. The consideration of the input is very simple since it is just a matter of dc measurements.

---

[1] J. Kurshan, R. D. Lohman, and G. B. Herzog: "A transistor curve tracer," *Electronics*, p. 122; February, 1953.

[2] G. C. Sziklai, "Current oscillator for television sweep," *Electronics*, p. 120; September, 1946.

[3] G. C. Sziklai, R. D. Lohman, and G. B. Herzog, "A Study of Transistor Circuits for Television," Proc. I.R.E., p. 708; this issue.

The output waveform may best be considered in two parts. The effective value of the sawtooth-current portion is one-quarter of the peak-to-peak value. The flyback portion of the wave is sinusoidal and, therefore, the effective value of the voltage is equal to the peak-to-peak amplitude divided by $\sqrt{2}$. Both the peak-to-peak current and voltage may be determined with the use of an oscilloscope.

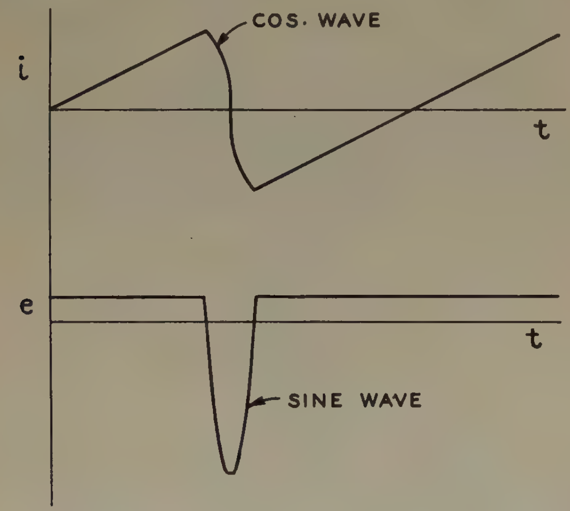


Fig. 16—The current and voltage waveforms in a horizontal deflection yoke.

The deflection power factor is then

$$PF = \frac{1/t_2 - t_1 \int_{t_1}^{t_2} i_{batt} e_{batt} dt}{1/t_2 - t_1 \int_{t_1}^{t_2} I_y E_y dt} \doteq \frac{i_{dc} e_{dc}}{\dfrac{I_{pp}}{2\sqrt{3}} \times \dfrac{E_{pp}}{\sqrt{2}}}$$

$$\therefore \quad PF \doteq 4.9 \frac{i_{dc} e_{dc}}{I_{pp} E_{pp}}.$$

This power factor may not be considered the exact equivalent of the conventional cos ϕ, but it may be used in the same manner and it may be expressed in percentages by multiplying the final value by 100.

As a numerical example a transistor deflection circuit used for the deflection of a 5-inch kinescope is computed.[3] Peak flyback voltage is 120V, sawtooth amplitude is 1.2 A p-p and dc drain is 70 ma from 13V; thus the power factor is 3.1 per cent. It is interesting to compare this figure with the 8 per cent obtained in the best tube circuit. The figure quoted for the tube circuit does not take the filament power into consideration.

At this point it may be interesting to consider a breakdown of the losses. The yoke loss may be calculated from Q measurements made at both the retrace frequency (55 kc) and at half the sweep frequency (7,900 cps). About equal losses occur during the retrace and the sweep period. Core and skin-effect losses dominate in the retrace period, while the resistance losses dominate during the forward-sweep period. (A typical yoke Q is about 25 at both frequencies.) The deflection-power factor of a commercial yoke is about 1.6 per cent. A circuit using a perfect switch, therefore, would have a power factor of about 1.6 per cent or approximately half the transistor circuit with currently available yokes.

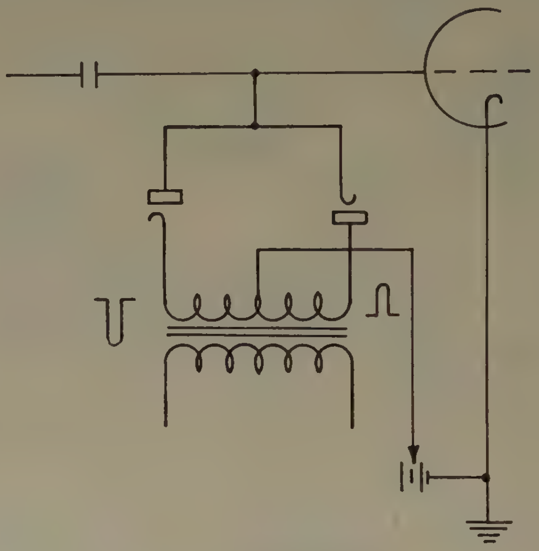


Fig. 17—A diode-clamp circuit.

V. A Symmetrical Clamp Circuit

A conventional diode clamp circuit is shown in Fig. 17. At some given time (blanking or the like) push-pull pulses are applied to two diodes connected bi-directionally. The diodes connect the grid and charge the coupling capacitor to a predetermined potential applied to the center tap of a transformer. After the pulse, the coupling capacitor retains its charge. The potential thus applied then forms the ac axis for the signal until the next pulse comes along. The push-pull transformer may be replaced by a triode phase splitter coupled through RC networks.

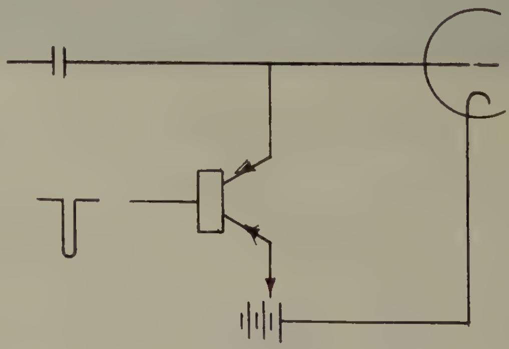


Fig. 18—A transistor-clamp circuit.

A symmetrical transistor connected as shown in Fig. 18 provides a simple clamp circuit. The circuit requires a single pulse (negative for p-n-p or positive for n-p-n transistors), which essentially shorts the emitter-collector path during the clamping interval.

VI. Modulator and Detector Circuits

A symmetrical transistor can be arranged to provide a simple balanced modulator. The signal to be modulated is applied between the emitter and the collector in series with a load circuit, and the modulating signal is applied to the base with respect to either of the other two electrodes. The modulating signal can also be applied between the base and the center of the load circuit. Bias voltages can be applied in series with either of the two signals. When the absolute value of either of the signals is zero, the output is also reduced to zero.

Another interesting application of a symmetrical unit is a dc-controlled alternating-phase reverser. Since the emitter and the collector are interchangeable in a symmetrical unit, a grounded-emitter stage becomes a grounded-collector stage by merely reversing the polarity of the power supply. The grounded-emitter form provides an inverted output, while the grounded collector provides an output with the same polarity as the input. Such a simple circuit could be used for color-phase alternation, periodic-signal cancellation, special visual displays, and so on.

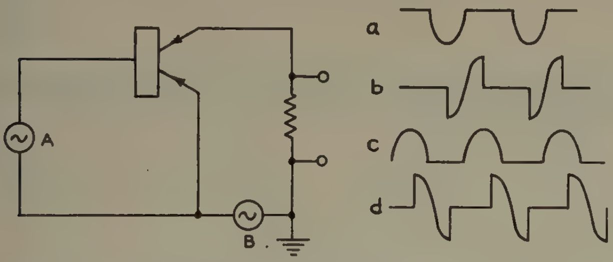


Fig. 19—Phase detector using a symmetrical transistor.

The symmetrical transistor also provides a simple phase detector in the simple connection shown in Fig. 19. When the signal sources A and B are in phase, the transistor conducts only during the negative cycle and the voltage drop across the load will be negative as shown in curve a. When the source A lags source B by 90 degrees, the output wave will be as shown in curve b and the dc output is zero. Between 0 and 90 degrees, the ratio of the positive and negative excursions and dc output will change gradually. The same condition holds with the opposite polarity between 90 and 180 degrees. When the two sources are 180 degrees out of phase, the collector is positive. When the base is biased negatively, the output wave will be as shown in curve c and the dc output is positive. At 270 degrees an oscillographic indication as shown in d is obtained. This trace can be differentiated easily from that obtained at 90 degrees due to its sequence. The dc output or amplitude ratio of positive and negative wave may be calibrated directly.

This type of phase detector can also be used for detecting the time relationship of a sawtooth and a pulse and thus provide automatic phase control in television-synchronizing circuits.

The phase-detecting principle may also be used in FM reception. A simple FM detector using a symmetrical transistor is shown in Fig. 20. The transformer is fed directly from a signal generator, the intermediate frequency amplifier of a conventional FM signal receiver or the like. The FM signal output of the source appears across the base-emitter path of the p-n-p transistor. During the positive portion of the wave applied to the base, the emitter-collector path of the p-n-p transistor is effectively open and therefore no current is flowing through the output resistor. During each negative swing, the emitter-collector path is conductive. The opposite relationship applies to n-p-n transistors.

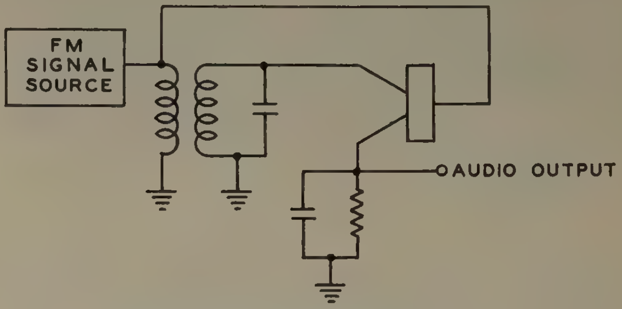


Fig. 20—A transistor FM detector.

The magnitude and direction of the current flow during the conductive periods, however, will be determined by the signal developed across the secondary of the transformer. The voltage across the secondary is 90 degrees out of phase with the voltage across the primary when the applied frequency is equal to the resonant frequency. Under that condition the dc-voltage drop across the load resistor will be zero, as it was shown in Fig. 19. As the applied frequency is changed, the secondary voltage lags the primary voltage by an angle less than 90 degrees if the frequency is increased, or it will lag by an angle more than 90 degrees if the frequency is decreased. A reversal of the transformer secondary naturally will change the lag to a leading-phase relationship. As the phase relationship is changed, the voltage developed across the load resistor will vary in accordance with the frequency modulation. It is of interest to note that as the signal amplitude is varied the current will tend to remain constant as it is indicated by the collector current and voltage curves of Fig. 1.

VII. Conclusions

The symmetrical properties of transistors provide a large variety of novel circuits which can be used with advantage in radio, radar, television and control equipments. The availability of p-n-p and n-p-n transistors permits direct coupling, single-ended push-pull operation, and efficient pulse amplification with a minimum number of components. Similar effects can be found in *n*-type and *p*-type contact transistors or *n* and *p*-channel unipolar transistors, and so forth. Similarly the single-unit symmetrical effect may be used in contact transistors, unipolar transistors or fieldistors. The alloying technique of transistor manufacturing is particularly suitable for the making of symmetrical units. An experimenter, however, can always take two asymmetrical units, connect them in parallel—with their emitters and collectors cross-connected—to investigate the behavior of symmetrical units in circuits.

ACKNOWLEDGMENT

The author wishes to acknowledge the helpful discussions with R. D. Kell, E. W. Herold, and W. M. Webster, R. D. Lohman and G. B. Herzog. Lohman and Herzog performed a number of the experiments indicated. The author also expresses his appreciation to R. R. Law, C. W. Mueller and D. A. Jenny for supplying symmetrical and complementary transistors.

APPENDIX

The gain of the direct-coupled amplifier shown in Fig. 7 may best be computed on the basis of iternative termination. This means that the load impedance of the stage is equal to the input impedance and the generator impedance is equal to the output impedance. This would be the exact case for one stage of an infinite chain of cascaded amplifier.

The following derivation uses the terminology suggested by L. J. Giacoletto.[4] The forward voltage amplification (which in the iterative case is the same as the current amplification) is given as

$$A = -\frac{y_{21}}{y_{22} + Y_L}, \qquad (1)$$

where Y_{21} is the forward-transfer admittance with the output shorted, Y_{22} is the output admittance with the input shorted and Y_L is the input admittance of the next stage. Neglecting the reactive components this relation may be rewritten for the common emitter circuit as

$$A = -\frac{g_{cb}}{g_{cc} + G_L}. \qquad (2)$$

The input conductance G_L is given by the relation

$$G_L = g_{bb} - \frac{g_{bc}g_{cb}}{g_{cc}G_L}, \qquad (3)$$

or

$$G_L{}^2 - (g_{bb} - g_{cc})G_L + g_{bc}g_{cb} - g_{bb}g_{cc} = 0, \qquad (4)$$

solving the quadratic

$$G_L = \frac{g_{bb} - g_{cc} + \sqrt{(g_{bb} - g_{cc})_2 - 4(g_{bc}g_{cb} - g_{bb}g_{cc})}}{2}. \qquad (5)$$

There are some very reasonable simplifications to be made at this point since $g_{bb} \gg g_{cc}$; also the input admittance is much higher than the product of the feedback conductance (g_{bc}) and the forward transadmittance with shorted output (g_{cb}).

The product of g_{bb} and g_{cc} is naturally much smaller than g_{bb} squared. On the basis of this reasoning the second term under the square-root sign is neglected.

$$G_L \doteq g_{bb} \qquad (6)$$

and (2) may be written as

$$A \doteq -\frac{g_{cb}}{g_{cc} + g_{bb}}. \qquad (7)$$

For those workers who are more familiar with the data given by Wallace and Pietenpol[5] the following transformations should be useful

$$r_{cb} = r_e + r_m. \qquad (8)$$

$$r_{cc} = r_e + r_c - r_m. \qquad (9)$$

$$r_{bb} = r_e + r_b. \qquad (10)$$

If r_e, which is usually very small, is neglected and the above values are substituted in (7) we obtain

$$A \doteq -\frac{r_m}{r_c - r_m + r_b}, \qquad (11)$$

which is trivially different from

$$\alpha_{cb} \doteq \frac{\alpha}{1 - \alpha} = \frac{r_m}{r_c - r_m}. \qquad (12)$$

In order to illustrate the difference between (11) and (12) the gain and the α_{cb} was computed for units No. 1 and No. 4 described by Wallace and Pietenpol.

	Unit No. 1	*Unit No. 4*
r_b	240	3,070
r_c	13.4×10^6	1.21×10^6
r_{c-m}	0.288×10^6	0.00422×10^6
α	0.9785	0.9965
α_{cb}	45.51	285
Ampl.	45.48	165.5

In conclusion it may be stated that the majority of present-day junction transistors are more like the unit No. 1 and therefore the α_{cb} is generally an acceptable approximation for the amplification of a direct-coupled unit as shown in Fig. 7. Since the current and voltage gain are identical in an iteratively coupled stage, the power gain is approximately α_{cb}.[2]

---

[4] L. J. Giacoletto, Terminology and equations for linear active four-terminal networks," *RCA Review*, p. 28; March, 1953.

[5] R. L. Wallace and W. J. Pietenpol, "Some circuit properties and applications of N-P-N transistors," *Bell. Sys. Tech. Jour.*, p. 530; July, 1951.

Transistor Negative-Impedance Converters*

J. G. LINVILL†, ASSOCIATE, IRE

***Summary*—Negative impedances having very stable characteristics are obtained with circuits using transistors. The physical characteristics of transistors, compactness, long life, simple power requirements, plus constancy of pertinent electrical parameters enhance their practical utility in the production of negative impedances.**

INTRODUCTION

NETWORK DESIGNERS have long been attracted to the potentialities of negative impedances. Their use in one form or another has been proposed for the reduction of parasitic losses, for the improvement of device characteristics, and for the design of new circuits impossible with purely passive elements. Vacuum tubes have been employed in the construction of negative impedances, and circuit configurations which exhibit negative impedances have long been known.[1–5]

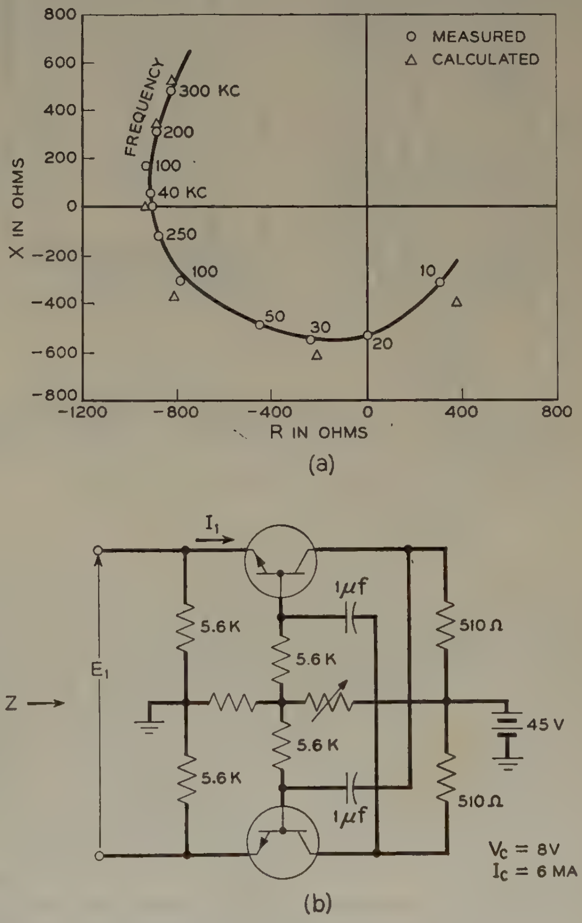
In the telephone plant negative-impedance repeaters[1] have been employed to reduce the loss on telephone lines. The inherent limitations of vacuum tubes, their bulkiness, relatively short life, requirement of a heated filament, deterioration with age, and limited ruggedness have deterred a broader application of negative impedances. A wider usefulness of these circuits is made possible by the appearance of the transistor which, apparently, possesses none of these practical limitations and, in addition, has desirable electrical characteristics.

Junction transistors are particularly adapted for application in a circuit called a negative-impedance converter. Ideal negative-impedance converters are active four-poles which are completely characterized by two properties: the input current equals the output current and the input voltage equals the negative of the output voltage. Thus negative-impedance converters act impedance-wise as a sort of ideal transformer in which the input impedance is the negative of the load impedance.

Transistor converters are good approximations to ideal converters; the physical converter can be represented as an ideal converter with an impedance-conversion factor in the range -0.90 to -0.98, with a parasitic-series resistance at the input of a few tens of ohms. The conversion properties of the transistor converter are stable; the conversion factor depends, principally, upon the alpha of the transistors and this parameter varies insignificantly with bias conditions. The useful frequency range of transistor converters extends into the hundreds of kilocycles.

NEGATIVE-IMPEDANCE CONVERTERS—BALANCED OPEN-CIRCUIT STABLE TYPE

A simple qualitative explanation of the negative-impedance converter circuit shown in Fig. 1(b) is as follows: Practically all of the current I_1, going into the transistor, flows out of the collector into the load, developing a voltage across it. This voltage is cross-coupled by the condensers back to the bases of the transistors, and thence to the input terminals practically undiminished because of the low impedance of the operating transistor between emitter and base. Hence input voltage is practically the negative of voltage across the load, and one sees at input the negative of load impedance.



(a)

(b)

Fig. 1(a) and (b)—Open circuit stable negative-impedance converter and locus of its input impedance.

Actually, the emitter current can vary from the collector current by not more than a few per cent and the emitter-base resistance of typical units typically biased is about 25 ohms; hence this analysis is quite accurate.

---

* Decimal classification: R282.12×R145. Original manuscript received by the Institute, November 4, 1952.

† Bell Telephone Laboratories, Inc., Murray Hill, N. J.

[1] J. L. Merrill, "Theory of the negative impedance converter," *Bell Sys. Tech. Jour.*, vol. 30, pp. 88–109; January, 1951.

[2] G. Crisson, "Negative impedances and the twin 21-type repeater," *Bell Sys. Tech. Jour.*, vol. 10, pp. 485–513; July, 1931.

[3] L. C. Verman, "Negative circuit constants," PROC. I.R.E., vol. 19, pp. 676–681; April, 1931.

[4] E. W. Herold, "Negative resistance and devices for obtaining it," PROC. I.R.E., vol. 23, pp. 1201–23; October, 1935.

[5] E. L. Ginzton, "Stabilized negative impedances," *Electronics*, vol. 18, pp. 140–144; September, 1945.

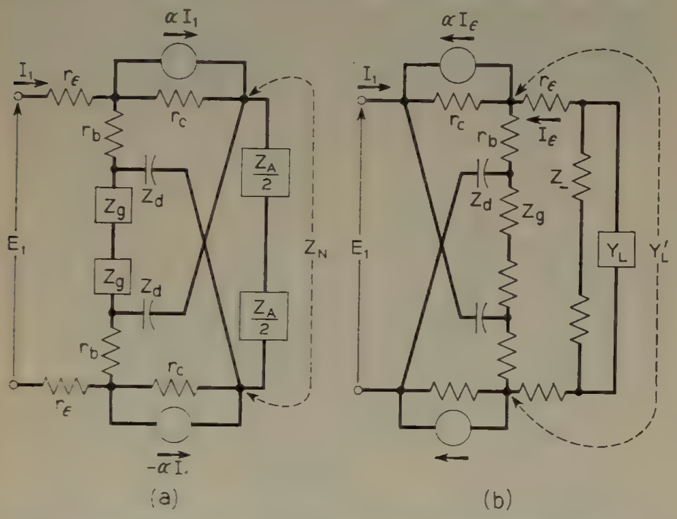
A direct analysis of the equivalent circuit of Fig. 2(a) indicates that the input impedance of the converter is

$$\frac{E_1}{I_1} = -\alpha Z_N \frac{Z_g}{Z_g+Z_d} + 2r_\epsilon + (1-\alpha)\left[2r_b + \frac{(2Z_d+Z_A)2Z_g}{2Z_d+Z_A+2Z_g}\right]. \tag{1}$$

or at the operating frequencies, where $Z_d \rightarrow 0$,

$$\frac{E_1}{I_1} = (1-2\alpha)Z_N + 2r_\epsilon + (1-\alpha)2r_b. \tag{2}$$

The only approximation made in arriving at the above relations is that Z_A/r_c is negligible, a very good approximation for practical circuits with a load in the thousands of ohms as r_c is of the order of megohms.



(a) (b)

Fig. 2—Equivalent circuits of open- and short-circuit stable converters. (a) Z_n is the parallel combination of Z_A and $2Z_d+2Z_g$.

$$\text{(b) } Y_L' = \cfrac{1}{2r_\epsilon + \cfrac{1}{Y_L + \cfrac{1}{2Z}}}.$$

Since the alpha's of good transistors are between 0.95 and 1.0, the multiplier of Z_N in (2) is close to the ideal value of -1.0. The deviation of the input impedance from $-Z_N$ associated with the second and third terms of (2) is small also: r_ϵ is inversely proportional to emitter current being 13 ohms at 2 ma.; the third term is a few per cent of r_b, which is a few hundred ohms.

The independence of the input impedance with respect to the point of operation is important in the negative-impedance converter. In this connection, the transistor circuit is very good indeed. The significant quantity, α, varies insignificantly with the point of operation. The emitter resistance, r_ϵ, is inversely proportional to emitter current, but its value is so small that this variation is of no consequence for load impedances above a few hundred ohms.

The locus of measured-input impedance of a converter which was constructed is shown in Fig. 1(a) along with a number of calculated points which were evaluated using (1). In connection with the calculation, it should be pointed out that the α of transistors is frequency-dependent, varying roughly according to the relationship

$$\alpha = \frac{\alpha_0}{1 + jf/f_{c\alpha}}, \tag{3}$$

where $f_{c\alpha}$ is called the alpha cut-off frequency. The cut-off frequency used in the calculation of high-frequency points shown on Fig. 1(a) is 1.75 mc.

The fact that the locus of input impedance of the circuit of Fig. 1(a) encloses the origin in the clockwise sense indicates that the circuit is open-circuit stable. Open-circuit stability is a characteristic of converters in which the emitters are at the input terminal pair, independent of the nature of the passive load or of the cross-coupling networks, as is proved in the Appendix.

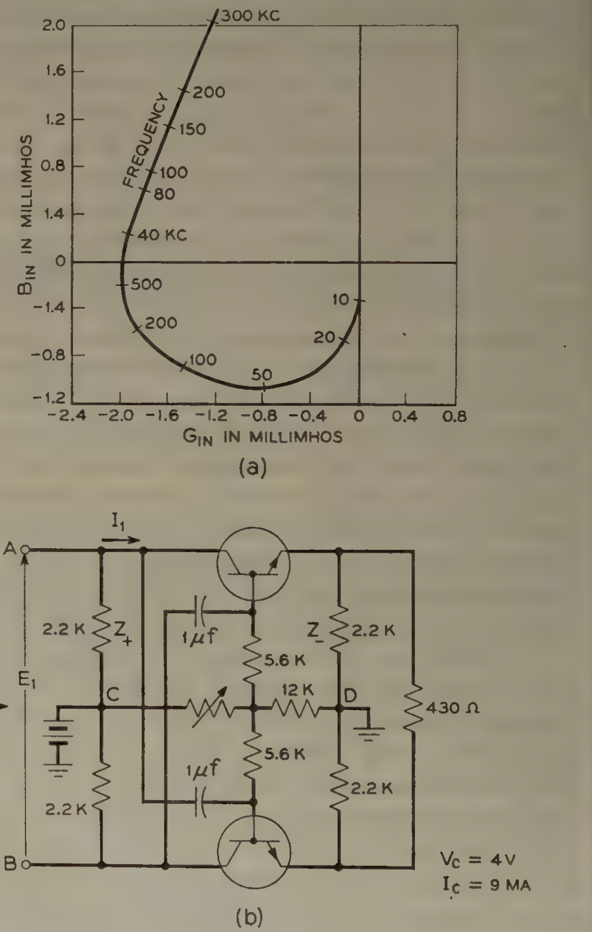


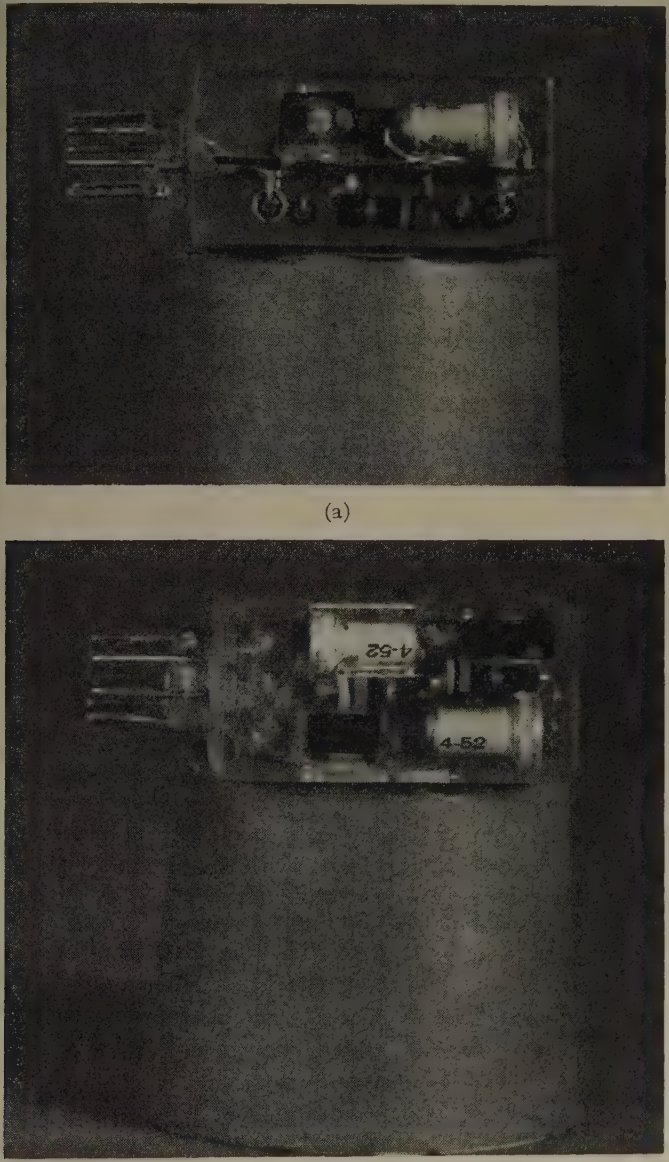
Fig. 3(a) and (b)—Short circuit stable negative-impedance converter and locus of its input impedance.

NEGATIVE-IMPEDANCE CONVERTERS—BALANCED SHORT-CIRCUIT STABLE TYPE

The circuit diagram of the short-circuit stable converter is shown in Fig. 3(b), and the equivalent circuit of the significant part of it is shown in Fig. 2(b). A straightforward analysis of the equivalent circuit indicates the input admittance to be

$$\frac{I_1}{E_1} = \frac{-\alpha Y_L' + \dfrac{1}{2Z_g} + (1-\alpha)\left[1 + \dfrac{r_b}{Z_g}\right] Y_L'}{1 + \dfrac{Z_d}{Z_g} + (1-\alpha) Y_L' \left[2r_b + \dfrac{Z_d}{Z_g}(2r_b + 2Z_g)\right]}. \quad (4)$$

From (4) it is apparent that in the short-circuit stable type, deviations from ideal character, i.e., $I_1/E_1 = -Y_L'$, are small but of different nature from those in the open-circuit stable type.


(a)

(b)

Fig. 4(a) and (b)—Two views of a short-circuit stable converter in a plastic plug-in unit ($\frac{3}{4} \times \frac{3}{4} \times 2$ in.).

Fig. 3 shows element values of a circuit which was constructed, and the locus of measured-input admittance over a wide range of frequencies. The fact that the locus (only a part of which is shown in Fig. 3) encloses the origin in the clockwise sense indicates the short-circuit stability of the device. It is shown in the Appendix that any converter of the type shown in Fig. 3 (the input terminals are at the collectors) will be short-circuit stable with a resistive termination independent of the nature of the passive cross-coupling networks provided that the magnitude of alpha remains less than one. Also the converter must be stable (short-circuit) for any passive load provided that alpha is real and less than one.

A plastic plug-in unit including transistors, cross-coupling condensers, and biasing circuits of a short-circuit stable converter is shown in Fig. 4.

In connection with the overload characteristics of the converters, it is important that as the open-circuit stable type is overloaded, the amount of negative input resistance decreases. As the short-circuit stable type of converter is overloaded, the amount of negative input conductance decreases. These statements indicate that the circuits are less susceptible to oscillation when overloaded than when they are under normal load levels.

UNBALANCED NEGATIVE-IMPEDANCE CONVERTERS

In the telephone repeater application, the balanced configurations of converters described in the foregoing are ideal. However, for other applications, it is frequently desirable to have a common-ground connection. It is desirable, also, in an active circuit to have the power supply grounded. A small change in the circuits already described adapts them to the unbalanced configuration.

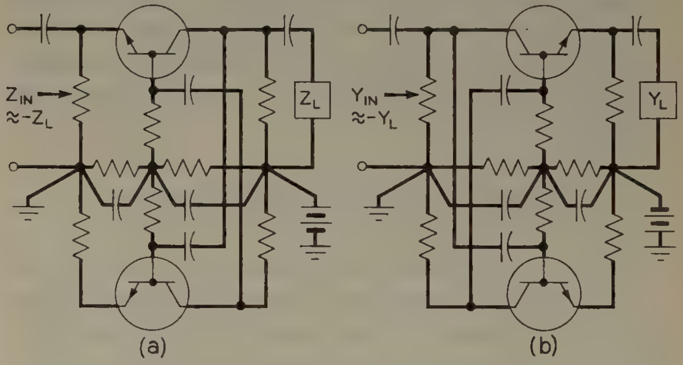


Fig. 5—Unbalanced negative impedance converters. (a) Open-circuit stable type. (b) Short-circuit stable type.

Fig. 5 shows unbalanced negative-impedance converters of both the open-circuit stable and the short-circuit stable types. It is interesting that in the unbalanced converters, the roles of the two transistors are quite different. In the figure, the upper transistor in each type plays the same role that the transistors of the balanced circuits played. The load current passes through it. However, the lower transistors in Fig. 5 act as phase inverters. They essentially sense the phase of voltage at the collector of the upper transistor and feed to its base a voltage of the opposite phase. The phase inverters could be replaced by suitable transformers or phase-shift networks if it were desirable to do so.

THE APPLICATION OF TRANSISTORS TO NEGATIVE-IMPEDANCE REPEATERS

Vacuum-tube converters have been employed successfully in the exchange plant as negative-impedance repeaters. Transistor converters are more nearly ideal converters than are the vacuum-tube version. Deviation from ideal character in the vacuum-tube model depends upon limited size of g_m and the inequality of $\mu-1/\mu+1$ to 1. Corresponding deviations from ideal character to that obtained in a transistor model with parameter values typical of junction transistors would be obtained with a triode having a g_m of 47,000 micromhos and a μ of 50.

In the application of a negative-impedance repeater, the input terminals of the negative-impedance converter are placed in series or in shunt with the line, the output being terminated in an appropriate passive network. Thus connected, the repeater increases the transmission of the line in both directions. If a repeater is to be connected in series with the line, an open-circuit stable converter is used. Open-circuit stable repeaters are also called the series type for this reason. If the repeater is to be connected across the line (called a shunt repeater), a short-circuit stable converter is used.

One very significant merit of the transistor repeater is the fact that changes in the supply voltage cause small changes in the negative resistance that is presented at the input terminals. For central office applications this point is not of great importance, but there is possibility of using transistor repeaters along the line where they are supplied by the voltage between the wires. One negative-impedance repeater exhibited a decrease in negative resistance of less than 5.5 per cent as the supply voltage was changed from 45 to 12 volts, a decrease in voltage of 73 per cent.

DESIGN FOR MAXIMUM UNDISTORTED POWER OUTPUT

The design for maximum-undistorted power output for converters is similar to that used in designing Class A pentode amplifiers. In both cases, the power output is limited by the allowable quiescent dissipation which, for the transistor, is V_cI_c, V_c and I_c being the quiescent-collector voltage and current. In the converter the amplitude of incremental voltages and currents for the input terminals, the output terminals, and the collectors of the transistors are practically the same. Hence for distortion-free operation, the maximum magnitudes of the ac components of voltage and current at all of the points are V_c and I_c. The quiescent operating point is determined by the allowable dissipation, V_cI_c, and the load impedance, V_c/I_c. The maximum power available at the input terminals, half of the allowable dissipation of a transistor, is 25 mw for the M1752 transistor. Actually, part of this power is lost in the biasing resistors at the input. Laboratory circuits were constructed which provided powers out as high as 17 mw.

DESIGN TO MINIMIZE EFFECT OF TEMPERATURE SENSITIVITY OF THE SATURATION CURRENT I_{co}

Junction transistors are not greatly influenced by changes in temperature, except in one respect. The collector current which flows in the absence of emitter current, I_{co}, is extremely temperature sensitive. Proper design of converter circuits can make its effect on circuit performance small. At toom temperatures I_{co} ordinarily amounts to a few microamperes. For junction transistors of type M1752, the change in I_{co} from room temperature to 150F can be expected to be less than 100 microamperes. The effect of increased I_{co} is to decrease the maximum-power output by decreasing the amount of signal which leads to distortion. In some circuits the changes in I_{co} are amplified and reduce very greatly maximum-undistorted power output. Analysis of the equivalent circuit of Fig. 6 with the two pessimistic approximations, $r_c=\infty$, $\alpha=1$, gives the relationships

$$\Delta i_e \cong \Delta I_{co}\frac{R_g+\dfrac{R_1R_2}{R_1+R_2}}{R_-+r_e}, \tag{5}$$

$$\Delta I_c \cong \Delta I_{co}\left\{1+\frac{R_g+\dfrac{R_1R_2}{R_1+R_2}}{R_-+r_e}\right\}, \tag{6}$$

$$\Delta V_c \cong -\Delta I_{co}\left[R_g+\frac{R_1R_2}{R_1+R_2}+R_+\left\{1+\frac{R_g+\dfrac{R_1R_2}{R_1+R_2}}{R_-+r_e}\right\}\right]. \tag{7}$$

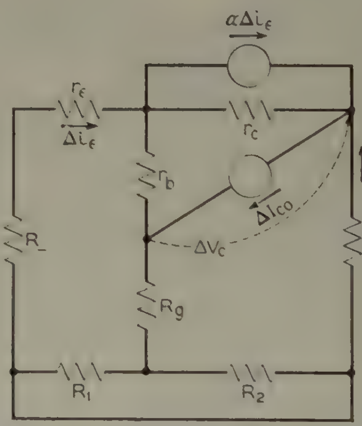


Fig. 6—Equivalent circuit to determine effect of ΔI_{co}.

On the basis of (6) and (7), to minimize variations in the point of operation, one should keep the ratio

$$\frac{R_g+\dfrac{R_1R_2}{R_1+R_2}}{R_--r_e}$$

to small values. The change in I_c of a few hundred microamperes, obtained when the above ratio is a few units, is still a small fraction of the usual quiescent-collector currents which are a few milliamperes.

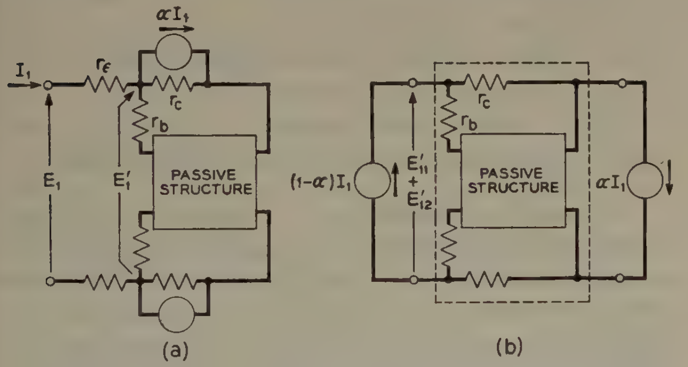
ACKNOWLEDGMENT

The author is pleased to acknowledge the suggestions of R. L. Wallace, J. L. Merrill, J. A. Weller, and G. Raisbeck. Wallace observed that transistors should be ideal in the El type of repeater and suggested a first-circuit configuration to effect the substitution. Merrill and Weller have given suggestions on the negative-impedance repeater problem in general and on the application of transistors to it. Wallace and Raisbeck have made helpful comments on revision of the manuscript.

APPENDIX

Open and Short-Circuit Stability of Different Types of Converters

The property of open-circuit stability holds for transistor converters in which the input terminals are the emitter terminals, independent of the nature of the load or the cross-coupling networks, as long as these are passive. For converters in which the input terminals are the collectors of the transistors, one finds the property of short-circuit stability from the input terminals holds, independent of the nature of the passive cross-coupling network, for any resistive load as long as $|\alpha| \leqq 1$, or for any passive load as long as α is real and less than 1.



(a) (b)

Fig. 7(a) and (b)—Open-circuit stable converter with arbitrary cross-coupling and equivalent circuit.

The open-circuit stability of the converter shown in Fig. 7 is identified with the fact that the impedance,

$$Z = \frac{E_1}{I_1},$$

has no poles in the right half of the complex-frequency plane.[1] The impedance Z is simply

$$2r_\epsilon + \frac{E_1'}{I_1}.$$

One can evaluate

$$\frac{E_1'}{I_1}$$

as being

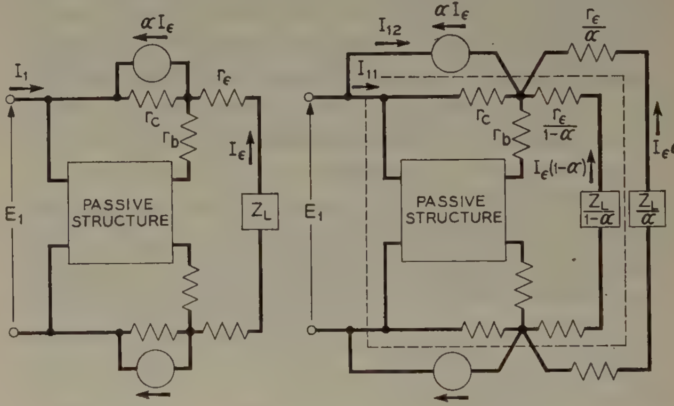
$$\frac{E_{11}'}{I_1} + \frac{E_{12}}{I_1}$$

for the structures shown in Fig. 7(b), where E_{11}' is associated with the left source and E_{12}' is associated with the right source. Clearly,

$$Z = \frac{E_1}{I_1} + 2r_\epsilon + Z_{11}(1-\alpha) + Z_{12}(\alpha), \tag{8}$$

where Z_{11} and Z_{12} are the driving-point and transfer impedances of the passive four-pole shown in the dotted lines of Fig. 7(b). The poles of Z are the poles of Z_{11}, which are the same as those of Z_{12} and the pole of α which is in the left half-plane. The poles of Z_{11} are in the left half-plane since the structure is a passive one. Hence this type of converter must be open-circuit stable.

A converter in which the input terminals are at the collectors is shown in Fig. 8. The short-circuit stability is to be verified by the fact that the input admittance $Y = I_1/E_1$ has no poles in the right half of the complex-frequency plane. To evaluate Y one considers Fig. 8(b) in which I_1 is represented as the sum of the current through the current generator, plus that into the other structure, I_{11}. The emitter and load currents are split into two paralleled parts. The current I_{12} is simply $-\alpha I_\epsilon$, and $(1-\alpha)I_\epsilon$ is determined as the product of E_1 and the transfer admittance Y_{21} of the structure shown inside the dotted lines in Fig. 8(b). By consideration of Fig. 8(b), one sees that



(a) (b)

Fig. 8(a) and (b)—Short-circuit stable converter with arbitrary cross-coupling and equivalent circuit.

$$Y = \frac{I_1}{E_1} = \frac{I_{11}}{E_1} + \frac{I_{12}}{E_1} = Y_{11} + \left(\frac{-\alpha}{1-\alpha}\right)Y_{21}, \tag{9}$$

where Y_{11} and Y_{21} are the driving-point and transfer (from input to loop containing $Z_L/1-\alpha$) admittances of the network shown in Fig. 8(b) inside the dotted lines. This network is certainly a passive structure if α is real and less than one, or if $|\alpha| \leqq 1$ and Z_L is resistive. The poles of Y_{11} and Y_{21} are those of Y; and under the above conditions, the passivity of the network inside the dotted lines of Fig. 8(b) assures that these poles lie in the left half-plane. Hence the type of converter illustrated is short-circuit stable.

Measurement and Control of the Color Characteristics of a Flying-Spot Color Signal Generator*

R. C. MOORE†, SENIOR MEMBER, IRE, J. F. FISHER†, SENIOR MEMBER, IRE,
AND J. B. CHATTEN†, ASSOCIATE MEMBER, IRE

INTRODUCTION

THIS PAPER DESCRIBES the optical system and measuring techniques which were developed for a flying-spot color-television signal generator with the features of excellent fidelity over the full range of physically realizable color, flexibility of adjustment, and adaptation for special tests.

CHARACTERISTICS SOUGHT

Unlike the ear, the eye is incapable of conducting a spectrum analysis of the input energy which stimulates it. Whereas a listener can in some degree recognize the individual frequency components which are contained in a given tone or chord, even the skilled viewer cannot recognize the individual component colors of a color mixture. The human eye evaluates color on the basis of the integrated intensity of the light components lying within three nonexclusive broad bands. By consideration of color mixture data, the International Commission on Illumination concluded that for purposes of color specification, the three bands were those shown in Fig. 1.[1] These are the familiar $\bar{x}$, $\bar{y}$, and $\bar{z}$ curves modified by normalization to equal maximum amplitudes. According to the CIE procedures, the appearance of a given colored light to the standard observer is determined by the magnitudes of three quantities, X, Y, and Z which are the total amounts of light power passed by filters having transmission characteristics described by $\bar{x}$, $\bar{y}$, and $\bar{z}$ respectively, when the given light is supplied to each. The quantities X, Y, and Z are positive for all physically realizable colors.

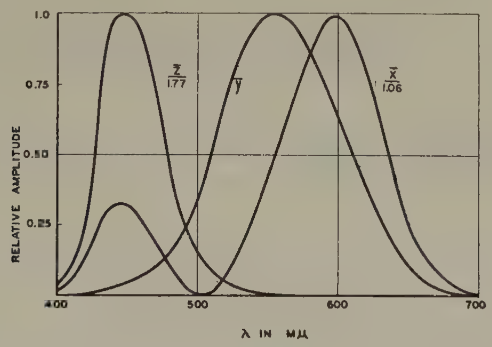


Fig. 1—Normalized characteristics of CIE standard observer.

Since the purpose of the camera, or scanner, is to derive such information from the scene as will permit accurate color reproduction to be made, it is necessary for greatest fidelity that the camera or scanner evaluate the quantities X, Y, Z, which are of most importance to the eye. Evaluation of linear combinations of X, Y, and Z is equally satisfactory, as the basic quantities may be extracted from them by an electrical process of linear addition and subtraction which has come to be known as "matrixing." It should be noted that a clear distinction exists between the spectral characteristics of a camera, which are tools for analysis, and the primary colors of a color display, which are tools for synthesis.

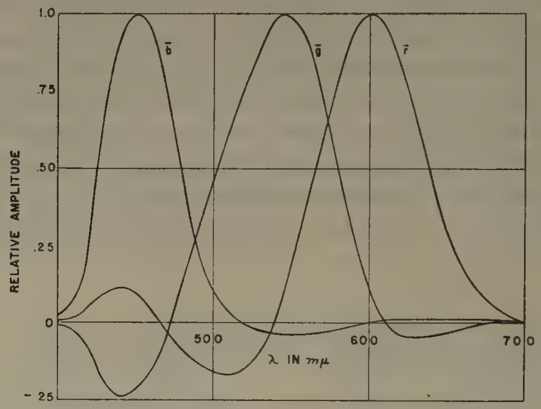


Fig. 2—Camera spectral characteristics for panel 7 primaries.

For greatest color fidelity of a reproducer in a linear system, the electrical signals supplied to it must be linear combinations of X, Y, and Z information. Different particular sets of receiver primary color sources require different combinations of X, Y, and Z information for their activation. For the NTSC Panel 7 primaries which are at the color points[2]

	Red	Green	Blue
x	.670	.210	.140
y	.330	.710	.080

it can be shown that the signals required by the three primary light sources are[3]

$$E_R = K_R[1.91E_X - .53E_Y - .29E_Z]$$
$$E_G = K_G[-.98E_X + 2.00E_Y - .03E_Z]$$
$$E_B = K_B[.06E_X - .12E_Y + .90E_Z]$$

where E_X, E_Y and E_Z are voltages proportional to the quantities X, Y, and Z respectively, of the light from a given part of the scene, and K_R, K_G, and K_B are constants determined by the brightness change per volt of the primary color sources of the display. Curves of the spectral characteristics which are required of the pickup device to derive these signals without need for matrixing are shown in Fig. 2. A feature of great significance is the requirement for negative lobes. Since this is awkward, optically, it is more convenient to secure these signals by combining, electrically, camera signals derived by pickup spectral characteristics which are such linear combinations of $\bar{x}$, $\bar{y}$, and $\bar{z}$ as have no negative lobes. Those characteristics will be designated as $\bar{x}'$, $\bar{y}'$, and $\bar{z}'$; the signals derived by using them will be designated as $E_{X'}$, $E_{Y'}$, $E_{Z'}$. These characteristics were sought for the flying spot scanner under consideration.

---

* Decimal classification: R355.912.2×535.6. Original manuscript received by the Institute July 7, 1952. Paper presented at the 1951 I.R.E. National Convention, New York.

† Philco Corporation, Philadelphia, Penna.

[1] W. D. Wright, "The Measurement of Colour," Adam Hilger Ltd., London, 1944, Chapter III.

[2] Report NTSC-P-13-162, October 23, 1951.

[3] F. J. Bingley, "Colorimetry in Color Television, Part I," delivered at I.R.E. National Convention, New York, March, 1951.

Measurement Procedure

A block diagram of the scanner optical system and measuring equipment is shown in Fig. 3; the parts shown dotted are for measurement purposes only. The general arrangement is conventional. The raster on the cathode ray tube is focussed by a lens on a transparent slide. Light from the flying-spot which scans the slide is gathered by the condenser and directed back to the filters and phototubes. A dichroic mirror reflects the blue light to a photomultiplier tube whose output is signal $E_{Z'}$. A suitable $\bar{z}'$ correcting filter is placed just before that photomultiplier tube. The red and green light is transmitted through the dichoric to a striped mirror which splits the light nonselectively to send one-half to the photomultiplier whose output is $E_{Y'}$ and the other half to the photomultiplier whose output is $E_{X'}$. Appropriate $\bar{x}'$ and $\bar{y}'$ correcting filters are placed in their respective light paths. The light splitter is a glass plate heavily silvered in narrow stripes. The image of the raster is considerably out of focus at this point and completely out of focus at the phototubes.

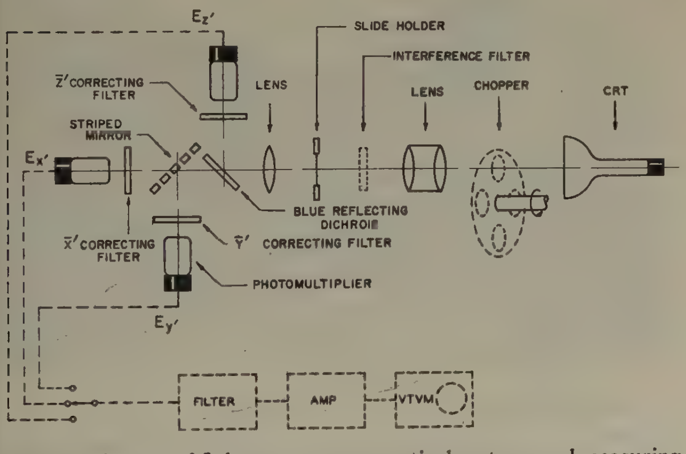


Fig. 3—Diagram of flying spot scanner optical systems and measuring equipment (measuring equipment shown dotted).

The spectral characteristic of a given channel is defined as the product of the spectral emissivity characteristic of the cathode ray tube light source, the spectral sensitivity characteristic of the photocell in that channel, and the spectral transmission characteristics of all optical elements between the cathode ray tube and that photocell.

Those parts shown dotted in Fig. 3 are the added instruments for measuring the spectral responses in the color channels. In customary fashion, the light is interrupted by a chopper disc placed just ahead of the lens, while the photocell output is measured by an ac voltmeter following filtering and amplification. The ac test conditions eliminate the disturbance of dc output from the photocells due to stray light reaching them. The spectral characteristics of the color channels are determined by a point-to-point amplitude measurement analogous to the electrical spectrum analysis of a broad band signal by a narrow band receiver tunable in steps. When a given interference filter is placed in the optical path, the light reaching each photocell is confined by that filter to a wavelength band 10 to 15 mμ in width. The photocell outputs are proportional to the respective color channel spectral characteristics, and to the transmission factor of the interference filter which is known. This relationship may be expressed as,

$$v = K \int_{400}^{100} CI d\lambda$$

in which,

v = photocell output voltage.
K = a constant for any channel, independent of the interference filter.
C = channel spectral characteristic, a function of wavelength, λ.
I = spectral transmission characteristic of interference filter.

With I confined to a narrow band with center wavelength λ_I we may write

$$v \Big]_{\lambda_I} = KC_{\lambda_I} \int_{400}^{700} I d\lambda.$$

The quantity $\int I_{d\lambda}$ is called the transmission factor of a given interference filter and was found by geometrically determining the area under the transmission vs. wavelength curve for that filter.

The value of the channel spectral characteristic at wavelength λ_I is then the quotient of the channel output voltage and the transmission factor of the interference filter that is placed in the light path. A number of interference filters having pass bands spaced throughout the visible spectrum are used in turn, thus yielding point by point data from which the channel spectral characteristic may be plotted.

In order to make the three channel characteristics the desired $\bar{x}'$, $\bar{y}'$, and $\bar{z}'$ functions, the following procedure is employed. First, the spectral characteristics of the channels without correcting filters are determined as described above. Next, the relative spectral transmission characteristics of the filters needed to correct these responses to $\bar{x}'$, $\bar{y}'$ and $\bar{z}'$ are computed from the data. After these correctors have been assembled and mounted in their respective light paths, the channel spectral characteristics are again measured. Finally, as may be necessary, the correctors are modified in structure or position to realize most accurately the desired performance.

A picture of the optical system including chopper and interference filter is given in Fig. 4. The chopper disc is enclosed in a protective housing, and the interference filter is mounted with spring clips on a convenient holder to facilitate the successive changes. The Type 4BP15 cathode ray tube has a zinc oxide phosphor and operates at 24 kv with 250 ua beam current, with a raster having a 3″ diagonal. Horizontal, but not vertical, blanking is applied to its grid during the spectral response measurements to minimize 60 cycle modulation of the light, but both horizontal and vertical blanking are used for normal picture operation. The chopper disc has 8 apertures and produces a chopping frequency of approximately 500 cycles. The electrical filter has a bandwidth of 50 cps. The main lens is a Zeiss Sonnar, f2 with 75 mm focal length. The X photomultiplier is a type 7138, while the Y and Z are type 5819. Approximately 1 kilovolt is supplied to their dynode divider chains.

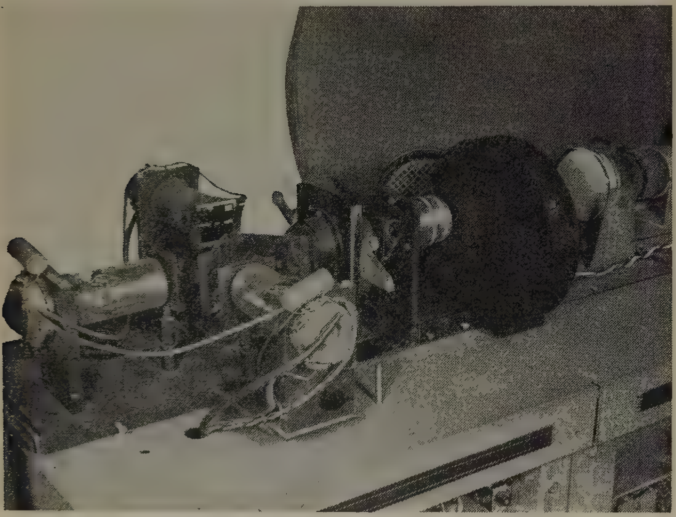


Fig. 4—Optical system including chopper.

RESULTS OBTAINED

Fig. 5 shows the spectral response measured to the 7138 photocell with the blue dichroic filter and the correcting filters removed. This illustrates the combined photocell and light source characteristic which is to be shaped into $\bar{x}'$, $\bar{y}'$, and $\bar{z}'$ form.

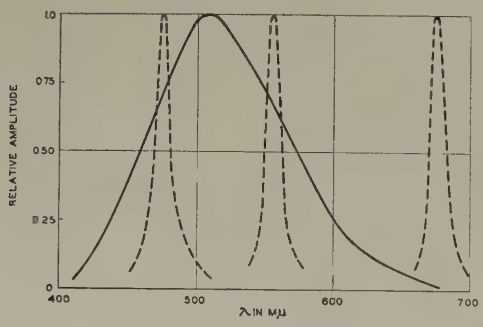


Fig. 5—Response of CRT and photomultiplier 7138 without blue dichroic or correcting filters; typical normalized interference filter characteristics.

The dotted curves are normalized typical interference filter transmission curves to illustrate their narrow transmission bands.

The original objective was to obtain channel spectral characteristics defined by:

$$\bar{x}' = 1.2\bar{x} - .2\bar{z}$$
$$\bar{y}' = \bar{y}$$
$$\bar{z}' = \bar{z}$$

This definition of $\bar{x}'$ closely approximates the shape of an $\bar{x}$ curve with the minor lobe removed. However, the final characteristics realized are given by

$$\bar{x}' = 1.2\bar{x} - .2\bar{z}$$
$$\bar{y}' = 1.4\bar{y} - .4\bar{x}' = -\ .5\bar{x} + 1.4\bar{y} + .1\bar{z}$$
$$\bar{z}' = \bar{z}$$

It was found experimentally that the modified $\bar{y}$ characteristic was easier to obtain. It was also realized that the best signal to noise ratio is likely to be obtained on E_R, E_G, and E_B signals if the three spectral characteristics have a minimum of overlap.

Fig. 6a shows $\bar{x}'$, $\bar{y}$ and $\bar{z}$ normalized to equal maximum amplitude from which it is seen that the general separation between the $\bar{z}$ curve on one hand, and the $\bar{x}'$ and $\bar{y}$ curves on the other hand makes feasible the selective light split which is accomplished by the blue reflecting dichroic mirror. The results of this split are shown in Fig. 6b. The extensive overlap between the $\bar{x}'$ and $\bar{y}$ curves prevents the use of a light split between them by a red reflecting dichroic; hence the nonselective striped mirror was employed.

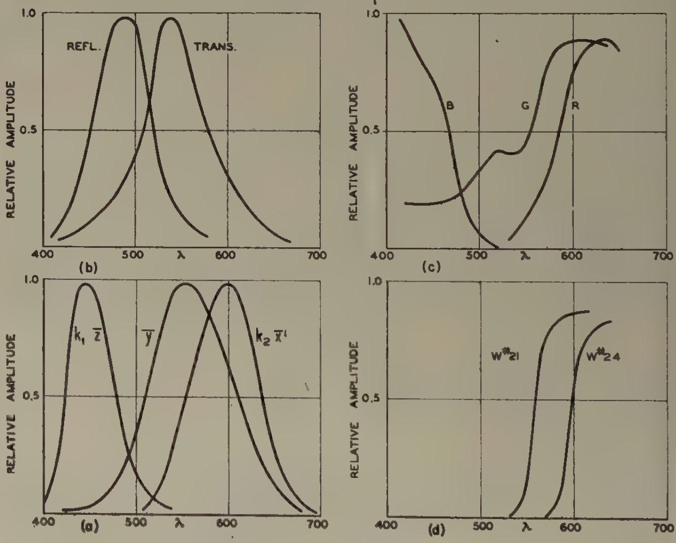


Fig. 6—(a) Desired responses; (b) Responses with blue dichroic; (c) Ideal correction filters; (d) Red corrector components.

The required correcting filters for each channel are shown in Fig. 6c. Since electrical gain knobs are available for adjustment of absolute signal magnitudes, it is relative transmission over the band of a given corrector that is important for the shaping process, not the absolute transmission. The ideal correction curves then agree in form, but not in absolute magnitude, to the quotients of the desired responses and the available light spectra of Fig. 6b. A Wratten filter, #34A, reasonably approximating the $\bar{z}'$ corrector was available and used.

No single filters suitable for the $\bar{x}'$ corrector and the $\bar{y}'$ corrector were found. Consequently, the desired corrector transmission characteristics were synthesized by combinations of Wrattens working in parallel, rather than in series. Since the corrector and photocathodes are illuminated over a fixed large area independent of the cathode ray tube spot position, a part of the light reaching a given photocathode may be passed through one correcting filter segment while another part of the light may be passed through another correcting filter segment to obtain this parallel operation. In Fig. 6d are shown curves for the two components, Wratten #21 and 24, in the $\bar{x}'$ corrector. The desired gentle cut was achieved by two sharp cut paths with different band limits. The gentleness and wavelength location of the net effective corrector characteristic is determined by the relative amounts of light which pass through each segment. This proportion is set approximately by constructing the corrector of suitable width strips of the Wrattens, one strip per component, held between slide glasses. For the $\bar{y}'$ corrector three components, Wrattens #7, #21, #24 were necessary. Fig. 7 shows a closeup of the scanner color head with the filters in place immediately before the photocells. The filters are held by spring clips with the strips horizontal and are mounted so that they may be moved vertically to permit fine control of the relative areas of segments illuminated. This provides a kind of pass band tuning adjustment to give the best overall results.

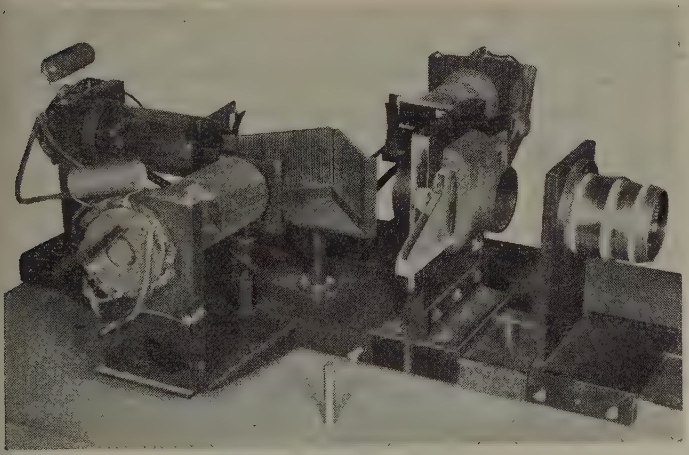


Fig. 7—Color head closeup.

The final channel spectral characteristics are shown in Fig. 8, with each channel depicted separately. The Z channel, Fig. 8b, departs from a $\bar{z}$ response principally in being somewhat too narrow. Drawing the intended and realized curves normalized to equal peak response exaggerates the apparent error, however, since in practice the normalization is made on an area basis when the electrical output amplitudes of the channels are equalized on white. The agreement of the $\bar{x}'$ response, Fig. 8c, with the intended $\bar{x}'$ curve is quite good. Fig. 8d shows the combination of the measured $\bar{x}'$ curve plus 17 per cent of the measured $\bar{z}$ curve; this is to be compared to a theoretical $\bar{x}$ curve which is dotted.

The $\bar{y}'$ Fig. 8a response departs from a $\bar{y}$ curve by lack of amplitude on the red side. The experimental curve is well defined by the $\bar{y}'$ expression previously stated. Final channel spectral characteristics, then, are reasonable approximations to linear combinations of $\bar{x}$, $\bar{y}$, and $\bar{z}$.

Measurements of the colors of standard Wratten filter samples by using the scanner as a colorimeter yielded the results shown in Fig. 9. The filters were placed in the slide holder and the color points computed from the measured electrical X', Y' and Z' values.

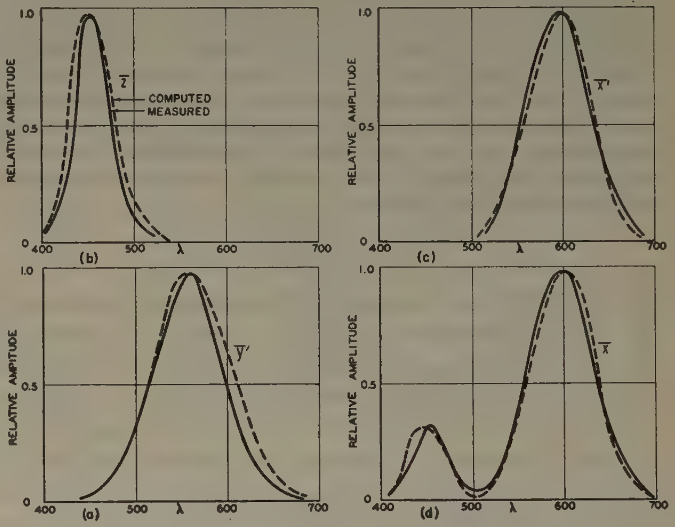


Fig. 8—Final channel spectral characteristics.

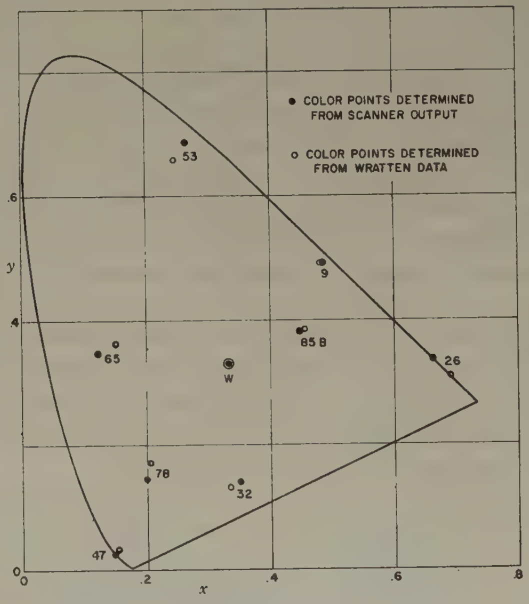


Fig. 9—Color point determinations.

Conclusions

In general, the objective of devising a color-signal generator with good fidelity over the full physical color gamut and with flexibility of control and adjustment was achieved. It was found that the CIE channel spectral characteristics could be realized, and that the synthesis of desired correcting filter characteristics by parallel path operation of segments of different component filters was practicable.

Punched-Card Controlled Aircraft Navigation Computer*

E. H. FRITZE†, MEMBER, IRE

Summary—**This paper presents the theory and a description of a course-line navigation computer for use with the presently available vhf omnirange navigation system or with the proposed complete omnirange-dme navigation system. A position fix may be obtained with the equipment by triangulation using line of bearing information from two omniranges. A further computation then produces course and distance indications with respect to an arbitrary ground point as selected by the pilot. Alternatively, position-fix information derived from an omnirange-dme ground station may be used as input data for course-line computation. The punched-card reference-data system and pictorial course display instrumentation associated with the computer are described.**

INTRODUCTION

DURING the last few years omnidirectional radio-range stations operating in the vhf portion of the radio spectrum have been installed throughout the United States by the Civil Aeronautics Administration (CAA).[1] An airborne navigation receiver tuned to a local omnirange provides continuous accurate information regarding the bearing of the ground transmitter with respect to the aircraft. Navigation receiver installations have been made in military and commercial aircraft of various types, and many of the larger aircraft carry dual omnirange facilities involving the use of two navigation receivers. With a dual installation, lines of position with respect to two separated ground transmitter sites can be determined simultaneously and a plot of these two lines of position on a chart will determine a position fix for the aircraft. The availability of such bearing information suggests the use of an analog computer to obtain a continuous position fix for an aircraft. Using such a fix, a further computation will produce course and distance indications which enable the pilot to fly the aircraft along a chosen course to an arbitrary destination. The equipment to be described computes such arbitrary courses based on a two bearing omnirange fix in one mode of operation.

The Radio Technical Commission for Aeronautics (RTCA) with representatives from the airlines, government agencies, and industry, have outlined a plan for the development and installation of additional aids to air navigation. Under this plan the CAA will ultimately install a distance-measuring equipment (dme) transponder at the site of each omnirange station. Aircraft which are equipped with airborne dme facilities will then have a continuous measure of distance as well as bearing to a selected ground station. It is anticipated that this rho-theta fix information will be used as input data for a course-line computer. The subject equipment will provide such computer service in a second mode of operation.

The use of a course-line navigation computer requires insertion of certain items of reference data. The manual insertion of these data by the pilot using hand-set knobs can become a burden in certain navigation situations. This is particularly true in omnirange triangulation operation. Circuits have been developed to insert such reference data automatically by means of a compact punched-card system. The use of this system reduces the requirement for control manipulation by the pilot and the attendant probability of insertion of erroneous data.

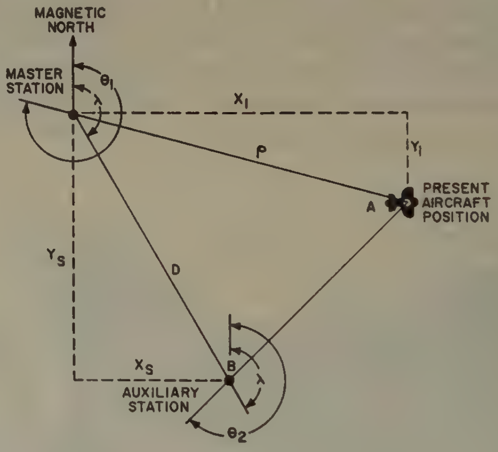


Fig. 1—Omnirange triangulation.

TRIANGULATION SOLUTION FOR DISTANCE

The triangle involved in this computation is shown in Fig. 1. The angles θ_1 and θ_2 are the omnibearings of two selected omnirange ground stations referenced to local magnetic north. The station bearing θ_1 degrees from the aircraft is termed the "master station," and that bearing θ_2 degrees is termed the "auxiliary station." The position fix is obtained by solution of this triangle for the distance ρ from the aircraft to the master omnirange station. Because of the use of two omnibearing inputs (θ_1 and θ_2) as primary information, the solution for distance is termed a theta-theta computation. The computed distance and the omnibearing of the master station give a continuous polar co-ordinate fix for the aircraft.

Let us consider first the case where θ_1 and θ_2 are based on the same north reference. The trigonometry of the solution for distance ρ can be carried out by application of the law of sines in terms of the angles *A* and *B* and

---

* Decimal classification: R526.12. Original manuscript received by the Institute, February 4, 1952; revised manuscript received December 4, 1952.

† Collins Radio Company, Cedar Rapids, Iowa.

[1] H. C. Hurley, S. R. Anderson, and H. F. Keary, "The civil aeronautics administration vhf omnirange," PROC. I.R.E., vol. 39, pp. 1506–1520; December, 1951.

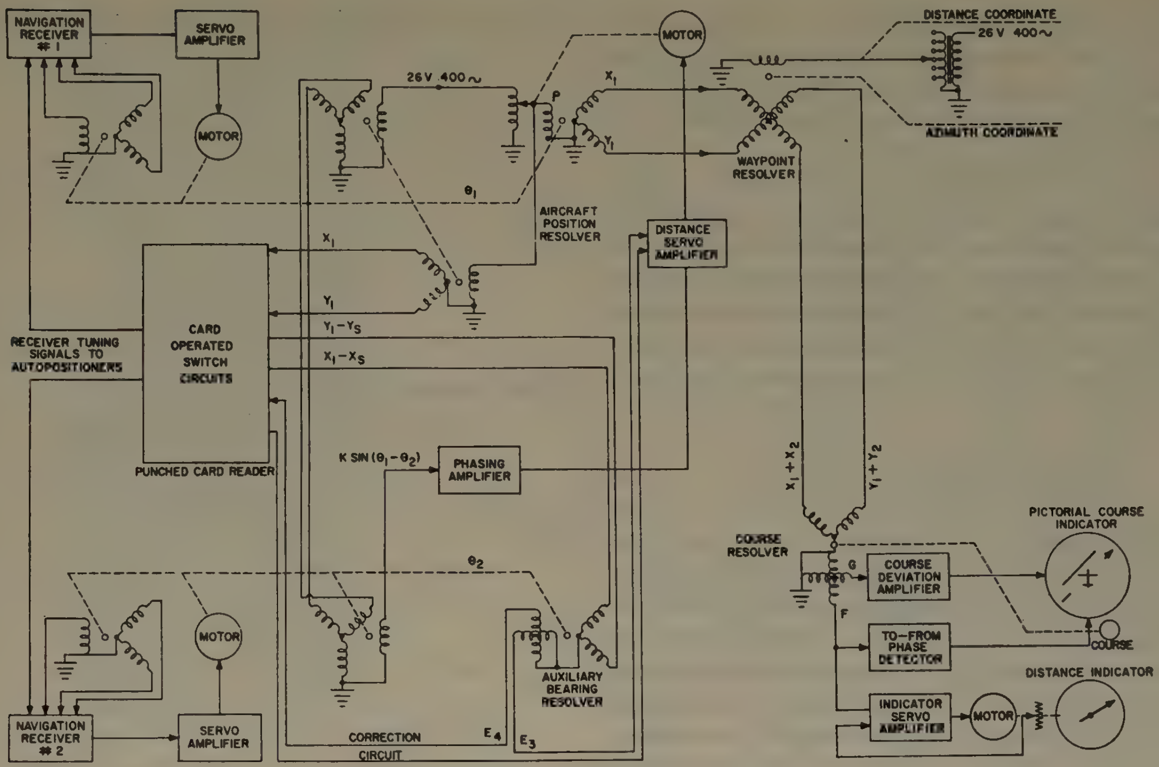


Fig. 2—Functional circuit diagram of computer

the side D of the triangle formed by the aircraft and the two stations:

$$\rho = D\frac{\sin B}{\sin A} \tag{1}$$

D = distance from master to auxiliary station

λ = magnetic bearing of auxiliary station from master station

$A = \theta_1 - \theta_2$

$B = \theta_2 - \lambda$

In addition to the angles θ_1 and θ_2 which are entered into the computer automatically by two vhf navigation receivers, the computation requires that information be supplied regarding the location of the auxiliary station with respect to the master station. These data remain fixed while the aircraft remains within the useful navigation area of a selected station pair.

It has proved more convenient in practice to introduce the station separation reference data in terms of rectangular rather than polar co-ordinates. The east-west and north-south separations are denoted by x_s and y_s in Fig. 1, based on magnetic north. To use this reference data, equation (1) may be expanded in rectangular co-ordinates:

$$\rho \sin(\theta_1 - \theta_2) = D \sin(\theta_2 - \lambda)$$

$$-x_1 \cos\theta_2 + y_1 \sin\theta_2 = y_s \sin\theta_2 - x_s \cos\theta_2$$

$$(y_1 - y_s)\sin\theta_2 - (x_1 - x_s)\cos\theta_2 = 0, \tag{2}$$

where

$$\left.\begin{aligned} x_1 &= -\rho\sin\theta_1 \\ y_1 &= -\rho\cos\theta_1 \end{aligned}\right\} \text{in terms of conventional omnibearings from aircraft to station.}$$

Fig. 2 is a diagram showing primary circuits of the computer as used with input bearing data from two navigation receivers. The equipment employs a voltage-distance analog and a computation scheme based on addition of rectangular components of the vectors involved in the navigation problem. Distance magnitudes are represented by proportional 400-cycle voltages with sign determined by in phase or out of phase relation to a reference voltage. Electromechanical resolvers are employed for the trigonometric operations required in the computation.

The master and auxiliary omnibearings are introduced by means of two omnibearing indicator servomechanisms which connect electrically with conventional circuits of the navigation receivers. The distance to station ρ is obtained by an implicit solution of (2) when θ_1 and θ_2 have a common reference. A 400-cycle voltage proportional to a trial distance ρ is applied to the input windings of the two aircraft position resolvers under control of a variable autotransformer driven by the distance motor. Corresponding rectangular co-ordinate voltages x_1 and y_1 describing the position of the aircraft with respect to the master station are obtained from the output windings of these resolvers. Voltages proportional to the station separation co-ordinates x_s and y_s are obtained from the punched-card system, to be described later. Voltages representing x_1-x_s and y_1-y_s are obtained by subtraction of the separation co-ordinates from the aircraft position co-ordinates at the output of one of the aircraft position resolvers. These proportional signals are applied to the input of the auxiliary-bearing resolver, as shown in Fig. 2, and resolution based on θ_2 produces at the output of this resolver the two signals shown as E_3 and E_4. E_3 is termed the "primary-error voltage" and E_4 the "correction-error voltage." Ignoring the correction error for the present, the primary-error voltage will be

$$E_3 = (y_1 - y_s) \sin \theta_2 - (x_1 - x_s) \cos \theta_2. \tag{3}$$

If this error voltage is applied as input to the distance-servo amplifier, a solution for ρ obtains when the error is driven to zero by servo adjustment of the variable autotransformer to satisfy (2). The distance servo must be phased in accordance with the sign of $\theta_1 - \theta_2$ as can be shown by examination of the expression for error. For an error $\Delta\rho$

$$\begin{aligned} E_3 &= \Delta y_1 \sin \theta_2 - \Delta x_1 \cos \theta_2 \\ E_3 &= \Delta\rho \sin (\theta_1 - \theta_2). \end{aligned} \tag{4}$$

The sense of the error signal thus varies with the sign of $\sin (\theta_1 - \theta_2)$. The phase sense of the servo is determined by the phasing amplifier shown in Fig. 2. The phasing amplifier receives an input signal corresponding to $\sin (\theta_1 - \theta_2)$ from the synchro link associated with the two omnibearing shafts. The phasing amplifier (which is essentially a 400-cycle phase detector) controls the phase sense of the distance servo through a relay.

In the foregoing discussion it has been assumed that bearings received from the two stations are based on the same north reference. Actually, each station is zeroed to local magnetic north, and therefore there is usually a difference in the angular reference of any two lines of bearing. The relatively short distances involved in the navigation triangle make possible a satisfactory solution by plane trigonometry provided that a correction is introduced for this north-reference difference. In practice, magnetic north at the master station is used as angular reference for the computation and the correction is applied to the auxiliary omnibearing. The required correction varies in range from zero to plus or minus several degrees depending on geographical location of the stations and their relative position.

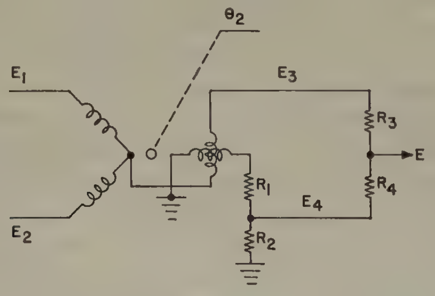


Fig. 3—Auxiliary bearing correction circuit.

The correction is introduced in a rather simple manner through use of the second output winding of the auxiliary bearing resolver. Fig. 3 shows the elements of this circuit. R_1 and R_2 form a low-impedance voltage divider while R_3 and R_4 act as a high-impedance-summing network for the two resultant signals. Suppressing the distance-voltage proportionality constants,

$$\begin{aligned} E_1 &= x_1 - x_s \\ E_2 &= y_1 - y_s \\ E_3 &= (y_1 - y_s) \sin \theta_2 - (x_1 - x_s) \cos \theta_2 \\ E_4 &= K(y_1 - y_s) \cos \theta_2 + K(x_1 - x_s) \sin \theta_2, \end{aligned}$$

where

$$K \cong \frac{R_2}{R_1 + R_2}.$$

These voltages may be summed to give

$$\begin{aligned} E_T = (y_1 - y_s)&(\sin \theta_2 + K \cos \theta_2) \\ &- (x_1 - x_s)(\cos \theta_2 - K \sin \theta_2) \end{aligned}$$

since

$$\sin \theta_2 + K \cos \theta_2 = \sqrt{1 + K^2} \sin (\theta_2 + \phi)$$

and

$$\cos \theta_2 - K \sin \theta_2 = \sqrt{1 + K^2} \cos (\theta_2 + \phi)$$

$$\begin{aligned} E_T = (y_1 - y_s)&\sqrt{1 + K^2} \sin (\theta_2 + \phi) \\ &- (x_1 - x_s)\sqrt{1 + K^2} \cos (\theta_2 + \phi), \end{aligned} \tag{5}$$

where $\phi = \tan^{-1} K$ is the desired correction angle. Comparison of (5) with (3) shows that the effect of adding the correction signal is the same as would result from a mechanical rotation of the auxiliary omnibearing shaft by an angle ϕ. The factor $\sqrt{1+K^2}$, which affects error loop gain, is approximately unity for the relatively small correction angles involved in the distance computation. A solution for ρ is obtained including the north-reference correction when the combined error signal of (5) is driven to zero by the computer. With the auxiliary bearing resolver zeroed with a 4-degree equivalent signal from the correction winding, corrections in the range of plus or minus 4 degrees can be obtained by the choice of a proper value for R_2.

Punched-Card System

A consideration of the number of items of reference data which must be entered into the computer to make possible the computation of distance ρ, using a given omnirange pair, shows that there are five such items. These consist of two omnirange frequency selections, two co-ordinates defining relative station position, and the north-reference correction angle. A computer which requires manual insertion of each of these data becomes burdensome in use because of the number of knob settings required. It is to be noted that the five items of reference data are completely determined by the selection of a given station pair. It would be desirable if the associated reference data could be introduced automatically as part of the station-selection operation.

A system has been developed which accomplishes this using punched cards as data-storing means. Fig. 4 is a photograph of a typical punched card containing com-

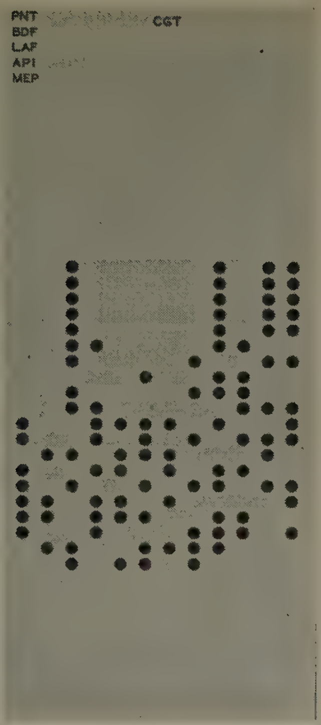


Fig. 4—Typical punched card.

puter data for five station pairs. CGT (Chicago Heights, Illinois) serves as master station for the entire card with possible choice of PNT (Pontiac, Illinois), BDF (Bradford, Illinois), LAF (Lafayette, Indiana), API (Naperville, Illinois), and MEP (Millersburg, Indiana) as auxiliary stations. Data for the two omnirange frequency selections and the three computer parameters are punched in the card. Five pairs with no common station can be set up if desired.

Since the solution for distance depends on triangulation, there is a region within which no usable distance computation is possible adjacent to and including the baseline connecting any station pair. Master and auxiliary stations must be selected so that the projected line of flight avoids this area. The use of punched-card data insertion aids in rapid selection of suitable station pairs and associated reference data as a flight progresses.

The reference information stored in the punched card is read out for computer use by a punched-card reader. This unit is pictured in Fig. 5 mounted in the overhead panel of a Beech D18S aircraft. Selection of a station pair is accomplished by positioning the card in accordance with the station-identification letters printed at the top. The punched cards for this service are made of a durable plastic material. The card reader operates by means of a bank of miniature switches which read out relevant information from the card for each of the five station settings provided. The switches are SPDT possible various binary circuit combinations.

The navigation receivers are remotely tuned from the cockpit by a manually operated frequency-control unit in conventional operation. The frequency-control system permits the selection of any one of 280 channels using nine control wires in a re-entrant circuit. The control circuit includes nine SPDT switches which are closed in various combinations to select a desired frequency. Tuning operations in the receiver are accomplished by motor-driven autopositioners employing

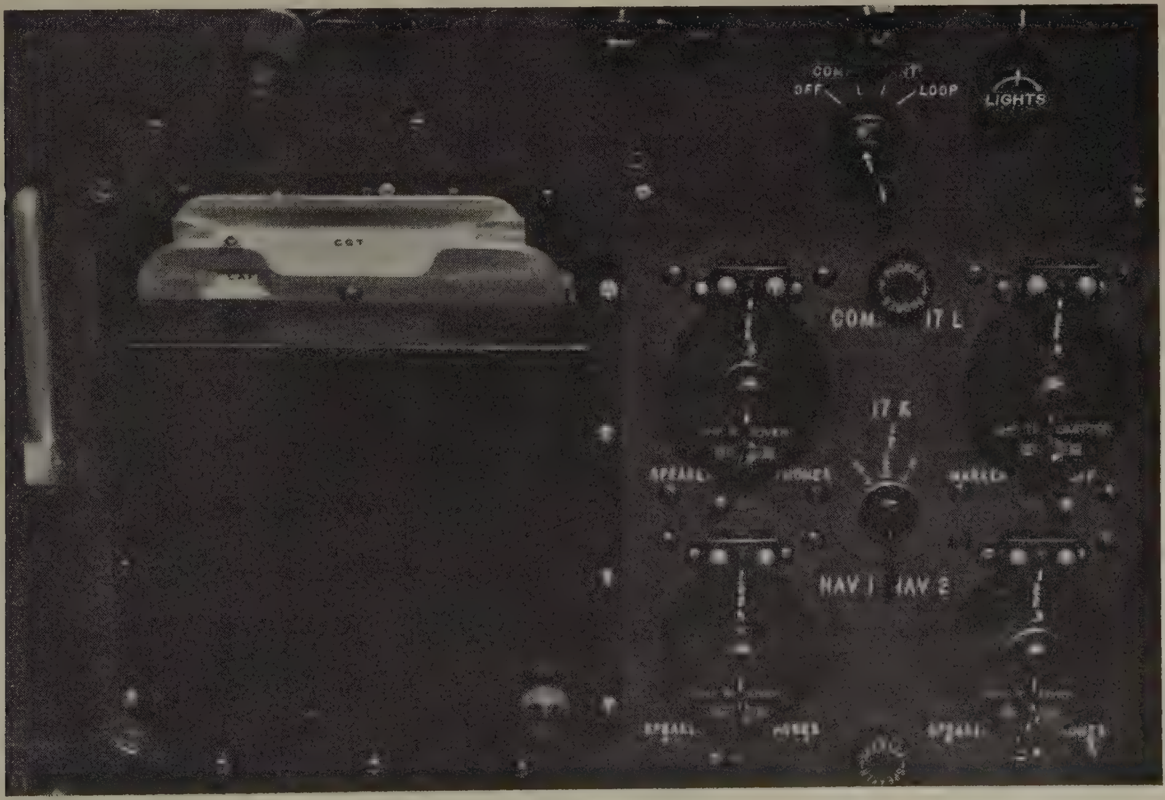


Fig. 5—Card-reader installation.

seeking switches which position tuning elements in accordance with the cockpit control setting.[2] As a result of the nature of these circuits, they are readily adapted to punched-card operation. Control wires are connected to switches in the punched-card reader in place of those in the frequency-control unit. Switching is provided in the card reader to automatically return the receivers to manual frequency control when the punched-card system is not in use.

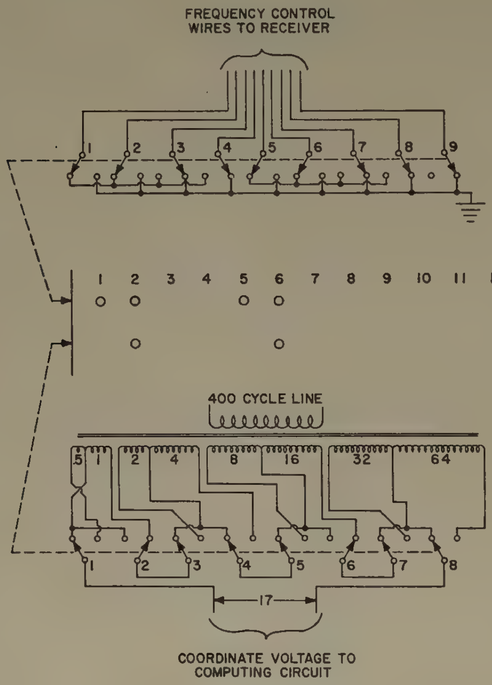

FREQUENCY CONTROL WIRES TO RECEIVER
1
2
3
4
5
6
7
8
9
1 2 3 4 5 6 7 8 9 10 11 12
400 CYCLE LINE
.5
1
2
4
8
16
32
64
1
2
3
4
5
6
7
8
17
COORDINATE VOLTAGE TO COMPUTING CIRCUIT

Fig. 6—Card-reading circuits.

In omnirange triangulation operation, ac voltages representing rectangular distance co-ordinates x_s and y_s of (5) are obtained from accurately wound tapped transformers under punched-card control. Fig. 6 shows typical circuits for frequency selection and for obtaining co-ordinate voltages. Proportional voltages can be selected in 0.5-mile steps over a range from 0 to 127.5 miles by operation of eight card-actuated switches in the binary addition arrangement shown. Sign is determined by two additional switches in a reversing connection. The north-reference correction of the auxiliary bearing is accomplished by punched-card control of the resistance R_2 of Fig. 3. R_2 is composed of a number of fixed resistors bridged by card-controlled switches. The desired correction is set up by shorting out appropriate resistors in accordance with the correction punching.

Airborne dme equipments also employ a switch-controlled frequency selection circuit and the punched-card reader can be arranged to tune a dme and an omnirange receiver automatically to a selected omnirange-distance ground station in rho-theta operation. Position co-ordinates required for arbitrary-course computation can also be set in by punched card as will be shown.

Arbitrary-Course Computation

In either theta-theta or rho-theta operation of the computer, the analog-position co-ordinates of the aircraft with respect to the reference ground station serve as inputs to a second section of the equipment. This is an arbitrary-course computer which has the basic function of translating station bearing and distance data into information fixing the location of the aircraft with respect to a course line through a destination chosen by the pilot. The chosen destination is referred to as a waypoint. It may be either an intermediate check point during the flight or the final destination of the aircraft. This portion of the equipment is also concerned with the display of output information to the pilot.

In theta-theta operation the position co-ordinates x_1 and y_1 are available at the output of the aircraft position resolvers as a result of omnirange triangulation. In rho-theta operation a reconnection of the distance servo amplifier (Fig. 2) sets up a voltage proportional to dme distance at the tap of the variable autotransformer associated with the aircraft position resolvers. This voltage is resolved into components x_1 and y_1, as before, on basis of omnibearing of ground station.

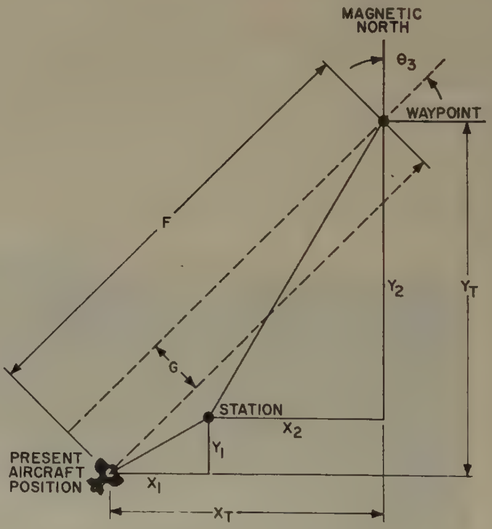


Fig. 7—Arbitrary course computation.

Fig. 7 is a diagram showing the addition of rectangular co-ordinates and resolution of vectors involved in the arbitrary-course computation. This computation requires that the position co-ordinates of the desired waypoint with respect to the reference ground station be set into the computer. These co-ordinates may be introduced either manually or automatically. In manual operation, the pilot sets in the magnetic bearing (azimuth) of the waypoint with respect to the station and the distance separating waypoint and station by means of a waypoint-selector instrument. These polar data are then resolved into corresponding rectangular co-ordinates x_2 and y_2. The circuit involved is shown in Fig. 2. A 400-cycle voltage is obtained from an accurately tapped transformer in accordance with the distance

---

[2] H. M. Schweighofer and A. H. Wulfsberg, "Multichannel remote control system," *Electronics*, vol. 25, pp. 202–210; February, 1952.

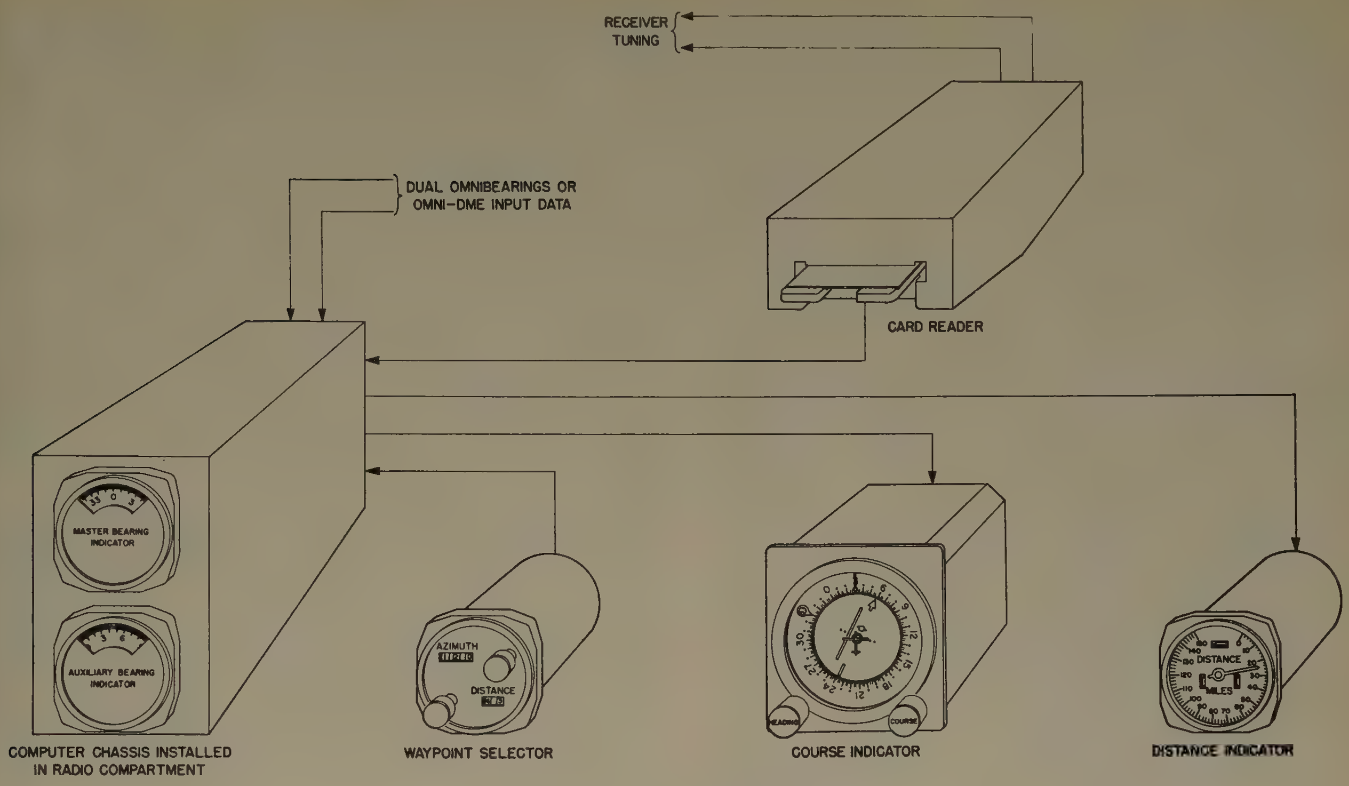


Fig. 8—Pictorial block diagram.

co-ordinate setting. This voltage is resolved into components x_2 and y_2 by the waypoint resolver based on the setting of the azimuth co-ordinate. In automatic operation the co-ordinates x_2 and y_2 are obtained directly from the punched-card reader in accordance with precoded data. The circuit required is the same as that shown in Fig. 6 for generation of x_s and y_s.

Manual waypoint selection has the advantage of extreme flexibility in choice of waypoint, but requires two co-ordinate settings. Automatic waypoint selection has the advantage of requiring no co-ordinate settings, but does require a predetermined flight route. All frequency selection and co-ordinate data for five waypoints can be coded in a single card to provide for several hundred miles of flight along a predetermined route. Manual and automatic operation may be used interchangeably with a switching arrangement.

The rectangular co-ordinate voltages describing the position of waypoint with respect to the aircraft are obtained by addition of waypoint co-ordinate voltages to outputs of the second aircraft position resolver.

$$x_T = x_1 + x_2, \qquad y_T = y_1 + y_2.$$

The pilot chooses his desired magnetic course to the waypoint with the same course selector used to select omnirange courses. The chosen course is specified as θ_3 in Fig. 7. The voltages describing x_T and y_T are resolved by the course resolver to a new set of axes as determined by the selected course to obtain a measure of the distance to go from present position along the course to the waypoint and the lateral deviation of the aircraft from the course. Distance to go is described as F and course deviation as G in Fig. 7.

$$F = x_T \sin \theta_3 + y_T \cos \theta_3 \tag{6}$$

$$G = x_T \cos \theta_3 - y_T \sin \theta_3. \tag{7}$$

The distance indicated is from the aircraft to a plane through the waypoint perpendicular to the selected course line. When the aircraft is on course, the direct distance to the waypoint is obtained. The voltages proportional to distance and course deviation as obtained from the output windings of the course resolver provide signals for the cockpit instrumentation circuits.

INSTRUMENTATION

Fig. 8 is a pictorial diagram of the computer and associated instruments. Output indications of the course computation are displayed in the cockpit by a course indicator and a distance indicator.

The course indicator is a multipurpose pictorial instrument which is intended for use in conventional omnirange flying and during Instrument-Landing-System (ILS) approach in addition to its application with the navigation computer.[3] This indicator combines information regarding aircraft heading and deviation from course in a manner which gives a pictorial display of the navigation situation. In use with the navigation computer, a course to the waypoint is selected by means of the course selector control of this instrument. The course resolver of the computer is located in the course indicator and the shaft of this resolver is positioned by the course selector control to accomplish the co-ordinate resolution of (6) and (7).

---

[3] W. G. Anderson and E. H. Fritze, "Instrument approach system steering computer," Proc. I.R.E., vol. 41, pp. 219–228; February, 1953.

The nature of the course display can best be explained by reference to Fig. 8. For the situation shown, the heading of the aircraft is 30-degrees magnetic as indicated by the angular position of the azimuth ring with respect to the stationary lubber line at the top of the indicator and the symbolic aircraft in the center. A computer course of 60 degrees has been chosen by means of the course selector which rotates the position indicating course bar within the azimuth ring. Once a course has been selected, the course bar rotates with the azimuth ring in response to heading changes. The course bar is moved across the face of the indicator in a direction perpendicular to the course in accordance with the lateral deviation of the aircraft from the selected course line. In the situation shown the selected course line is ahead of the aircraft. If the present heading is maintained, the course bar will move downward and to the right as the aircraft approaches the course line. An appropriate change in heading at the proper time will bring the aircraft on course. The course indicator presents a picture which is equivalent to what would be seen visually ahead of the aircraft if the selected course line were marked on the terrain below. The directional (to-from) indicator pointing in the 60-degree direction above the aircraft symbol shows the direction to the selected waypoint along the course line.

Circuits associated with the course indication are shown in block diagram form in Fig. 2. The 400-cycle voltage obtained from the "G" output winding of the course resolver is phase detected to produce a corresponding dc signal of proper polarity and in proportion to the course deviation. This signal is applied to the meter movement associated with the course deviation bar. Voltage from "F" output winding controls a similar phase detector which provides a dc signal to the meter movement associated with the to-from indicator.

The servo-driven distance indicator gives a position indication against a scale graduated in miles. It includes a linear potentiometer supplied from the 400-cycle line as a follow-up transducer. A voltage proportional to indicator-shaft position is obtained from the tap of this potentiometer. The distance output is produced by servo comparison of the course resolver distance voltage "F" with this shaft position voltage. The indication is unaffected by normal changes in supply voltage in this bridge arrangement.

The distance indicator also includes flag-alarm meters which indicate failure of certain signals from the navigation receivers, dme, or computer. In omnirange triangulation operation a flag indication is produced at any time the aircraft enters a region in which the difference in direction of the lines of bearing to the two stations in use is less than a preset angle. This flag indication is provided to prevent use of the triangulation fix in those regions along the station baseline and far out from a given station pair where satisfactory accuracy cannot be obtained. The signal for this purpose is obtained from the output of the phasing amplifier in accordance with the input signal, which is proportional to sin $(\theta_1-\theta_2)$.

Fig. 9 is a photograph of the computer and instruments. The computing circuits are housed in a standard 1/2 ATR aircraft case and involve a total of twelve vacuum tubes. The chassis is intended for installation

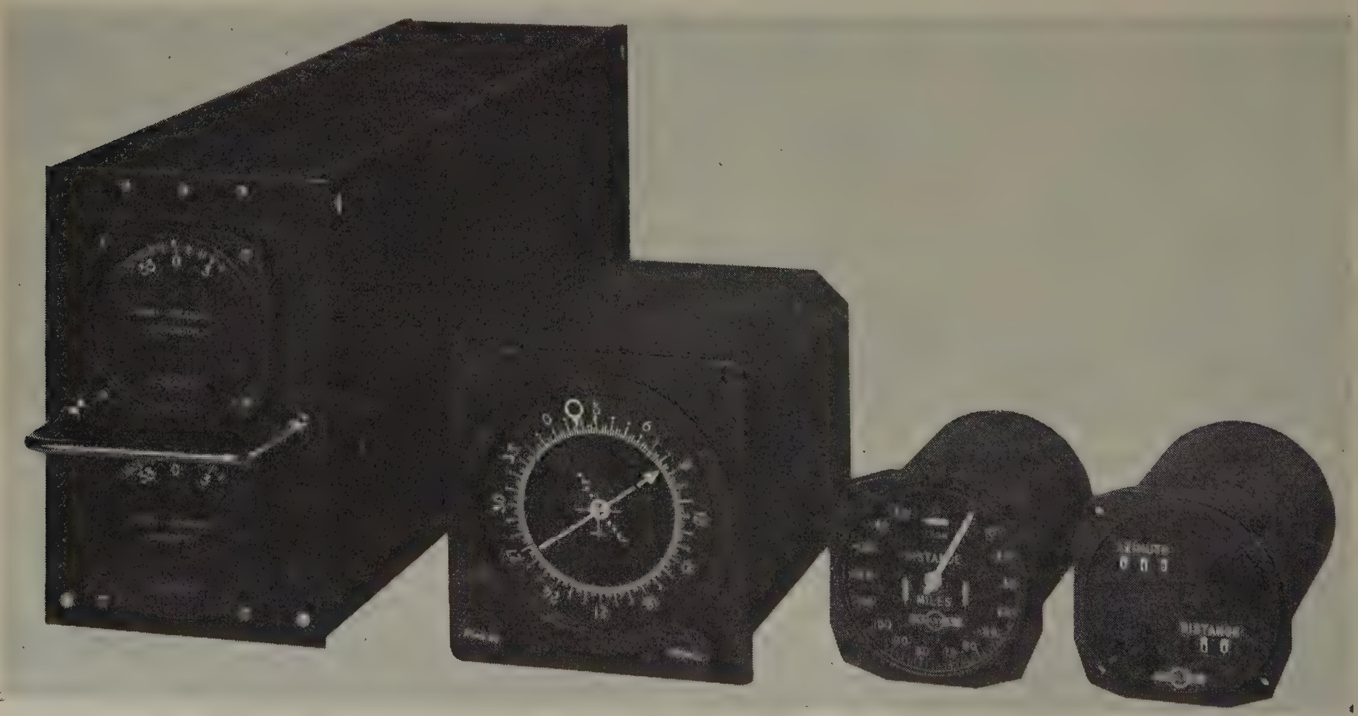


Fig. 9—Computer chassis and panel instruments.

in the aircraft radio compartment. Front-panel indicators on the computer chassis present input bearing readings for checking and calibration purposes.

USE WITH OMNIBEARING-DISTANCE INPUT DATA

At the present time airborne and ground dme facilities are available only on a limited basis; however, experimental installations have been made of airborne dme equipments and developmental models of several types of computers designed specifically for use with omnibearing-distance input data.[4] The airborne dme equipment includes a linear potentiometer as a data output device. When the dme is tracking, the position of the movable tap of this potentiometer is caused to be proportional to the distance from the aircraft to the ground station. One means which has been employed for introducing distance data into a course-line computer involves the use of a servomechanism. In this arrangement a voltage proportional to distance from the dme output potentiometer is matched by a like voltage obtained from a servo-driven low-impedance transducer in the computer. The transducer in the computer then serves as a suitable driving source for the computer resolver circuits.

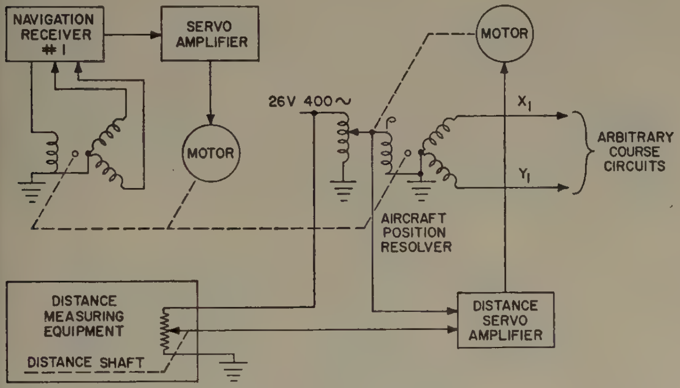


Fig. 10—Introduction of dme data.

Fig. 10 is a functional circuit diagram showing the manner in which the circuit elements which are associated with the triangulation solution for distance (Fig. 2) are reconnected for use with omni-dme input data. The phasing amplifier and the auxiliary-bearing servo system are not required for this mode of operation. The omnibearing of the reference ground station is introduced by the master-bearing servo system exactly as in triangulation. The distance servo amplifier drives the distance motor and variable autotransformer as before. The output potentiometer of the dme is excited from the same 400-cycle supply source as the variable autotransformer. The voltage at the tap of the autotransformer is continuously matched to that from the tap of the dme output potentiometer by the distance servo to provide an input system of the type mentioned in the preceding paragraph. The motor-driven autotransformer serves as a remote repeater and an impedance changer in this arrangement to supply the aircraft position resolver with an input distance voltage from a low-impedance source. The arbitrary course computation and instrumentation circuits of the computer remain as shown in Fig. 2. The use of the punched-card system to tune the airborne radio equipment and introduce precoded waypoint coordinates is optional.

PERFORMANCE

The navigation computer has been installed in a Beech D18S aircraft for more than a year during which time it has been used in omnirange triangulation operation. The equipment has been regularly utilized in normal operations of this aircraft which involve flights to various sections of the country. Flight tests have been conducted to gather data regarding the accuracy of the computer.

The ground-position accuracy of the computed course lines depends directly, of course, on the accuracy of the omnibearing data received. The subject of omnibearing accuracy is a complicated one and exhaustive investigations have been made by the CAA and others to evaluate the omnirange system.[1,5] Results of these investigations indicate that for ground stations where polarization errors have been minimized and which are free of serious reflecting objects, an accuracy of better than ±2 degrees can generally be expected. The better stations provide bearing information accurate to within 1 degree, while some stations which suffer from greater than ordinary reflection effects exhibit errors in certain quadrants of more than 2 degrees. Navigation receiver errors (for airline type equipment) can be held to less than 1 degree. Spurious reflections from ground objects and other propagation disturbances cause a certain amount of low-frequency fluctuation "noise" to be superimposed on the omnibearing data.

The nature of the trigonometric solution for distance in the computer is such that position errors caused by inaccuracy in the omnibearing input data are accentuated as the difference in direction of the two lines of bearing becomes small. Flight tests have shown that satisfactory computer courses can be obtained provided that the aircraft is within an area where signals from two omniranges can be received and where the lines of bearing to the two stations differ in direction by more than a minimum angle in the range of 15 to 20 degrees. The flag circuit associated with the phasing amplifier is adjusted so as to disable the computer and cause a flag alarm to appear in the distance indicator whenever the directions of the lines of bearing in use differ by less than a preset angle in this range. The pilot is thus informed of the need for choice of a different auxiliary station in such an area.

[4] L. E. Setzer, "The TDEC Course Line and Pictorial Computer Programs," Technical Development Report No. 138, Technical Development and Evaluation Center, Civil Aeronautics Administration.

[5] "Summary Report on Evaluation of the Omni-Bearing-Distance System of Air Navigation," Report 540-1, Airborne Instruments Laboratory, Inc.

TABLE I

CHECKPOINT LOCATION	MASTER STATION	AUXILIARY STATION	SELECTED COURSE	SELECTED WAYPOINT	ACTUAL DISTANCE	INDICATED DISTANCE	DISTANCE ERROR	OFF-COURSE ERROR
South of Mechanicsville, Iowa	MLI	IOW	86°	Rock River West of Dixon, Ill.	78 miles	77 miles	1 mile	South 1 mile
North of Lowden	MLI	IOW	86°	Rock River West of Dixon, Ill.	63½	63	½	South 1
North of DeWitt	MLI	IOW	86°	Rock River West of Dixon, Ill.	47½	48½	1	0
Elvira	MLI	IOW	86°	Rock River West of Dixon, Ill.	37½	39	1½	North 1
Clinton	MLI	IOW	86°	Rock River West of Dixon, Ill.	30	30½	½	North 3
West of Dixon, Illinois	MLI	BDF	86°	Rock River West of Dixon, Ill.	0	0	0	South 1
South of Franklin Grove	PNT	API	89°	Chicago Midway Airport	69	71½	2½	0
South of Steward	PNT	API	89°	Chicago Midway Airport	57½	58½	1	South 1
McGirr	PNT	API	89°	Chicago Midway Airport	47	48	1	South 1½
North Aurora	PNT	CGT	89°	Chicago Midway Airport	25½	24½	1	0
Chicago Midway Airport	PNT	CGT	89°	Chicago Midway Airport	0	1	1	South 1½

In bench tests of the computer for aircraft positions outside the flag region, an accuracy exceeding 1 per cent of full scale is generally obtained. The major portion of course and distance errors found in flight tests are traceable to corresponding omnibearing errors. Since a degree of bearing error corresponds to a mile or more of position error at 60 miles from a ground station, position errors of several miles can result in this distance range for stations of below average accuracy. The omnirange ground stations are continually being improved and a reduction in this maximum error spread is to be expected. Working with a pair of good omnirange stations and with omnirange receivers in proper calibration, course and distance errors average less than a mile over representative courses. Table I shows the results of a flight test over a 200-mile course from Cedar Rapids, Iowa, to Chicago, Illinois.

The computer has been used to indicate distance to touchdown during ILS approaches using bearings from a single omnirange within the local area of the field. In this mode of operation the magnetic direction of the runway line is used as a fixed master-bearing input to the computer and is set up by a synchro link acting through the master-bearing servomechanism. The runway direction is the constant line of bearing of the aircraft from the touchdown point to a close degree during a normal ILS approach. Auxiliary cross bearings are received from the local omnirange station located off the runway line. Position co-ordinates of the omnirange station from the touchdown point are set in by punched card. An expanded distance scale is used in the approach computation (15 miles full scale) to take advantage of the greater accuracy which can be achieved over the reduced ILS distance range. Table II lists results of such a distance measurement made along the ILS approach path at Des Moines, Iowa, using DSM as a source of cross bearings. Operation in this mode is dependent on the availability of a suitably placed omnirange station in the vicinity of the field.

TABLE II

CHECKPOINT	ACTUAL DISTANCE TO END OF RUNWAY	COMPUTER DISTANCE	MILES ERROR
Railroad	7.1	7.3	0.2
Highway	5.8	5.9	0.1
Outer marker	4.1	4.2	0.1
Inner marker	0.5	0.6	0.1
End of runway	0	0.2	0.2

ACKNOWLEDGMENTS

The writer wishes to acknowledge the assistance of his associates in the work described. In particular, the suggestions of W. H. Wirkler and the efforts of C. S. Carney contributed to this computer development.

* * *

Analysis of a Single-Ended Push-Pull Audio Amplifier*

CHAI YEH†

Summary—**This paper deals with a theoretical circuit analysis of a single-ended push-pull audio amplifier. Linear tube characteristics and small signals are assumed. The problem of impedance matching is first discussed. The properties and the requirements of a satisfactory driver stage are analyzed, and an output stage using an impedance matching output transformer is discussed. The effects of the plate-to-ground capacitance of the driver stage on the frequency-gain characteristic and of the choice of the tube and circuit parameters are analyzed. The paper concludes with some experimental results indicative of the inherant properties of the amplifier.**

IN A RECENT article by Peterson and Sinclair[1] special circuits have been suggested by which a high fidelity, low distortion audio amplifier can be constructed without using output transformers or in which the requirements of an output transformer can be greatly simplified. This paper will give a theoretical analysis of the basic circuit used by Peterson and Sinclair. It will be seen that many desirable characteristics of this amplifier circuit can be deduced from this analysis.

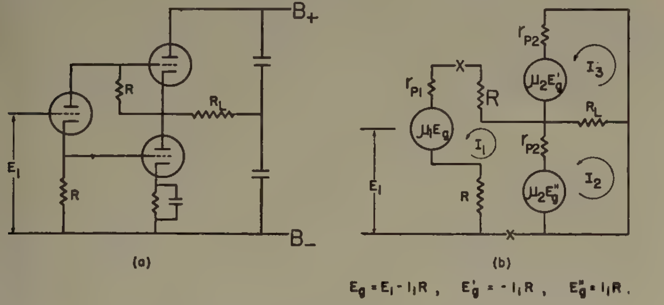


Fig. 1—(a) The basic circuit and (b) The equivalent circuit of a single-ended push-pull audio amplifier.

EQUIVALENT CIRCUIT OF THE BASIC SINGLE-ENDED PUSH-PULL AMPLIFIER CIRCUIT

The basic circuit of a single-ended push-pull amplifier is shown in Fig. 1(a). Assuming class-A operation with resistive load, and neglecting the effects of interelectrode capacitances, an equivalent circuit of the phase inverting driver stage and the single-ended push-pull output stages is shown in Fig. 1(b). With the circuit constants, tube parameters, and loop currents as indicated, one may write the following simultaneous equations:

$$\begin{aligned}
&I_1(2R+r_{p1}+\mu_1R)+I_2R_L && -I_3R_L && =\mu_1E_1,\\
&I_1\mu_2R && -I_2R_L && +I_3(r_{p2}+R_L)=0, \qquad (1)\\
&-I_1(r_{p2}+\mu_2R) && +I_2(r_{p2}+R_L)-I_3R_L && =0.
\end{aligned}$$

From which the individual loop currents can be evaluated. The net current flowing through the load resistance R_L is

$$I_3 - I_2 = \frac{-\mu_1E_1(2\mu_2R + r_{p2})}{R_L(4R + 2\mu_1R + 2\mu_2R + 2r_{p1} + r_{p2}) + r_{p2}(2R + \mu_1R + r_{p1})}. \qquad (2)$$

The power output P_0 is given by $P_0=(I_3-I_2)^2R_L$. The power sensitivity, which is defined as the ratio of the power output to the square of the input voltage is then given by:

$$\text{Power sensitivity} = \frac{P_0}{E_1^2} = \frac{\mu_1^2A^2R_L}{r^2_{p2}\left[1+\dfrac{R_L}{r_{p2}}(2+A)\right]^2} \qquad (3)$$

where

$$A = \frac{2\mu_2 + r_{p2}/R}{2 + \mu_1 + r_{p1}/R}.$$

The condition for maximum power sensitivity by varying the load resistance can be obtained by taking the derivative of (3) with respect to R_L and equating to zero. The optimum load required is thus

$$R_L \text{ (for maximum power sensitivity)} = \frac{r_{p2}}{2+A}. \qquad (4)$$

It can easily be proved that (4) also represents the source impedance of the amplifier. The value of this maximum power sensitivity is given by

$$\frac{P_{0\,\max}}{E_1^2} = \frac{\mu_1^2A^2}{4r_{p2}(2+A)}. \qquad (5)$$

To get high power output, A should not be small. But consideration of negative feedback (which will be discussed in the next section) puts restrictions on the choice of the tube parameters, and indicates that A should be small.

The ratio of power output to the maximum power possible is given by

$$\frac{P_0}{P_{0\,\max}} = \frac{4\dfrac{R_L}{r_{p2}}(2+A)}{\left[1+\dfrac{R_L}{r_{p2}}(2+A)\right]^2}. \qquad (6)$$

Equation (6) is calculated for various values of A and is plotted in Fig. 2 as the ratio of r_p^2/R_L is varied. It is seen that even for a wide variation of A, the matching condition permits r_p^2 to have a value of from two to three times that of R_L.

The above discussion on maximum power sensitivity made use of linear analysis with a resistive load. However, the actual maximum un-distorted power output, which is limited at one extreme by grid current and at the other extreme by plate current cutoff, will occur at higher load resistance values. The consideration of plate and screen-grid dissipation also favors higher load resistances.

---

* Decimal classification: R363,222×R132. Original manuscript received by the Institute, July 31, 1952; revised manuscript received, December 12, 1952.

† University of Kansas, Lawrence, Kansas.

[1] A. Peterson and D. B. Sinclair, "A Single-Ended Push-Pull Audio Amplifier," PROC. I.R.E., vol. 40, pp. 7–11; January, 1952.

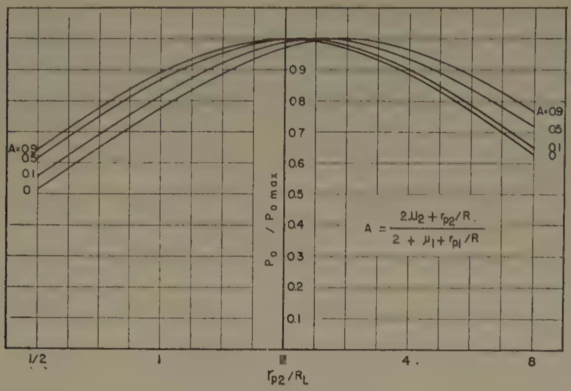


Fig. 2—Power sensitivity as a function of load resistance.

THE PHASE-INVERTING DRIVER STAGE

Information concerning the behavior of the driving stage can be deduced by solving for the current I_1 in (1). Thus

$$I_1 = \frac{-\mu_1 E_1}{r_{p1} + (2+\mu_1)R + R_L(2\mu_2 R + r_{p2})/(r_{p2} + 2R_L)}. \tag{7}$$

Equation (7) is in a form similar to that of an amplifier employing negative current-feedback if one considers the term $r_{p1}+(2+\mu_1)R$ as the internal resistance R_i and $(2\mu_2 R+r_{p2})R_L/(r_{p2}+2R_L)$ as the effective load resistance R_e of the driver. $\mu_1 E_1$ is the fictitious voltage.

The voltage across R_e is the actual voltage output of the single-ended push-pull output stage. The driving voltages for that stage is derived from the voltage drops through the resistances R. Thus the ac voltage across the plate-to-cathode of the phase inverting driver supplies both the driving as well as the output voltages. This puts a restraint on the dc plate voltage supply for the driver. A high dc plate voltage greater than the sum of these ac voltages is needed in order that serious non-linear distortion can be avoided.

The negative feedback that exists between the input and output of the amplifier stages can be expressed in terms of a feedback factor β, the ratio of the feedback voltage available at the grid terminal of the driver stage to the output voltage across the load. Thus

$$\beta = (2 + r_{p2}/R_L)/(2\mu_2 + r_{p2}/R). \tag{8}$$

The inherent feature of this negagive current feedback is to maintain the current I_1 practically independent of load changes. This would mean that the driving voltages for the output stages could also be maintained unchanged, a very desirable characteristic of the amplifier if we can achieve it. To so design this stage would either require

$$R_i >> R_e,$$

or

$$A/(2 + r_{p2}/R_L) << 1. \tag{9}$$

For a matched load, (9) becomes

$$A/(4 + A) << 1. \tag{10}$$

To satisfy the requirement indicated in (9) or (10), a small value of A is called for, but a smaller A means reduced output voltage and power output. A compromise should always be worked out between these contradictory requirements.

A proper choice of A gives some guidance for the choice of tube parameters and circuit constants. For a typical operation, if $\mu_1 \gg 1$, $r_{p1} \cong R$ and $R > r_{p2}$, then with a matched load for maximum power sensitivity

$$A \simeq 2\mu_2/(3 + \mu_1),$$

and

$$\beta \simeq 4/2\mu_2.$$

Thus, if μ_2 is small, μ_1 is large; A is very small and β is comparatively large. A larger β helps to reduce distortion while large power output is still possible if the input signal is large.

A choice yielding a larger value of μ_1 is always desirable. The larger value of μ_1 allows larger power output while still keeping the reasonably small value for A, which is required for constant I_1 operation. It also gives a larger driving voltage for exciting the power stage.

THE POWER OUTPUT STAGE

In the basic circuit of this amplifier, Fig. 1(a), if one assumes identical tube characteristics; same dc plate voltage per tube and equal and opposite grid swings, the ac plate currents add in the load in exactly the same way as in a conventional push-pull circuit and the distortion-cancelling feature is retained. The dc plate currents are, however, in series for the plate supply.

The need for a high voltage plate supply (from 800 to 1000 volts) with good regulation to operate this amplifier is, to a certain extent, an objection to most experimenters. If only a moderate plate supply is available, a circuit suggested by Peterson and Sinclair[2] containing an output transformer, is recommended. A modified version of their circuit is shown in Fig. 3. It uses an output transformer with separate primary windings. Here the dc plate currents of the two tubes flow through the two halves of the primary windings in opposite directions so that the problem of dc saturation is not acute. The tubes are in parallel across the dc plate supply. The signal currents flow through the two halves of the primary windings which are connected in parallel by the by-pass capacitors. The leakage reactance between the halves of the primary windings plays no important part in switching transients[3] and the requirements of the output transformer are not as critical as they were in conventional push-pull circuits.[2]

The linear analysis used thus far can be extended to include the impedance matching transformer provided class A_1 operation in triodes is assumed. Assuming an

---

[2] Peterson and Sinclair, *loc. cit.*

[3] A. P. T. Sah, "Quasi-transients in class-B audio-frequency push-pull amplifiers," PROC. I.R.E., vol. 24, pp. 1522–1541, Nov. 1936.

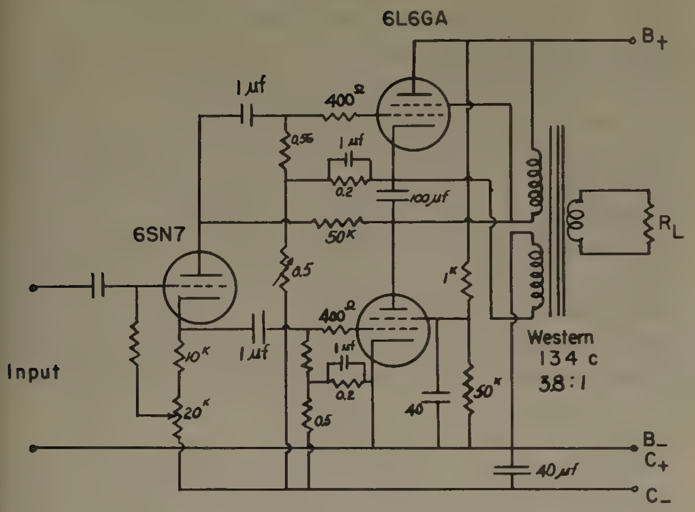


Fig. 3—Method of using an impedance matching transformer to put the output tubes in parallel across the dc plate supply taken from the paper by Peterson and Sinclair with modification to adjust the grid bias of the output stages independently.

ideal transformer, equivalent circuits of the output stage of a single-ended push-pull amplifier with impedance matching output transformer are represented in Fig. 4. Fig. 4(a) can be reduced to Fig. 4(b), which shows that as far as the varying components are concerned, the tubes are in parallel. Fig. 4(c) is another version of Fig. 4(b).

Fig. 4(b) and Fig. 4(c) are very similar to the equivalent circuit of a conventional push-pull circuit used for power considerations alone. Thus a simple relationship between these two types of push-pull circuits can be deduced. For impedance matching, the single-ended push-pull circuit will need an output impedance, which is one-fourth of the plate-to-plate impedance of a conventional push-pull circuit.

The concept of the composite tube, which is so helpful in the analysis of conventional push-pull circuits when the path of operation extends beyond the linear region of the plate characteristics, can be borrowed to advantage. Thus the analysis of the single-ended push-pull circuit can be extended to include the operation as class AB_1, although graphical analysis is required. To extend the operation beyond class AB_1 into class AB_2 or class B operations is not feasible, since the flow of grid current will affect the biases unless special circuits can be arranged.

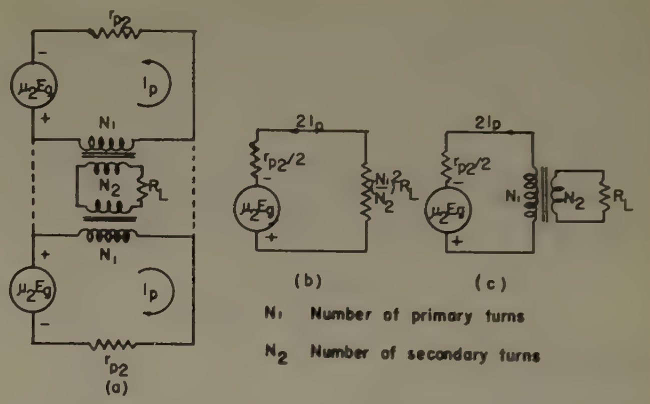


Fig. 4—Equivalent circuits of the output stage of a single-ended push-pull amplifier with impedance matching output transformer used to connect the output tubes in parallel across the dc plate supply.

THE EFFECT OF THE PLATE-TO-GROUND CAPACITANCE OF THE DRIVER STAGE ON THE GAIN-FREQUENCY CHARACTERISTICS OF THE AMPLIFIER

As was first pointed out by Peterson and Sinclair, the capacitance from plate to ground of the drive ${}_R$ stage is going to affect the gain of the amplifier at higher frequencies. With normal circuit and tube parameters, this effect will first be noticed at video frequencies. The previous analysis can be extended to include this effect. In Fig. 1(b), if a capacitor C (plate-to-ground capacitance) is connected across the points marked $x-x$, and a loop current is assigned to the loop on the right hand side of the capacitor, one has a new equivalent circuit for this analysis. As the currents flowing through resistances R are different now, we may expect different driving voltages on the grids of the output tubes. This difference is, however, small, if the shunting capacitance is small or the frequency in consideration is not too large. By writing the simultaneous equations of the loops and solving the currents as before, one obtains, for a sinusoidal input signal, the net current through the load resistance as

$$I_3-I_2=\frac{-\mu_1E_1\left[\mu_2+\dfrac{1}{j\omega CR}\left(2\mu_2+r_{p2}/R\right)\right]}{R_L\left\{\left(1+\mu_1+\dfrac{r_{p1}}{R}\right)\left[\left(2+\mu_2+\dfrac{r_{p2}}{R}+\dfrac{r_{p2}}{R_L}\right)\right]+\dfrac{1}{j\omega CR}\left[2\left(\mu_1+\mu_2+2+\dfrac{r_{p1}}{R}\right)+\dfrac{r_{p2}}{R_L}\left(2+\mu_1+\dfrac{r_{p1}}{R}+\dfrac{R_L}{R}\right)\right]\right\}}. \tag{11}$$

And thus the ratio of the voltage gains at higher and lower frequencies can be found by taking the ratio of (11) to (2), and is given by

$$K_h/K_L=\frac{\dfrac{\mu_2}{2\mu_2+r_{p2}/R}-j\,\dfrac{1}{\omega CR}}{\dfrac{\left(1+\mu_1+\dfrac{r_{p1}}{R}\right)\left(2+\mu_2+\dfrac{r_{p1}}{R}+\dfrac{r_{p2}}{R_L}\right)}{\left(2+\mu_1+\dfrac{r_{p1}}{R}\right)\left(2+\dfrac{r_{p2}}{R_L}+\dfrac{2\mu_2+r_{p2}/R_L}{2+\mu_1+r_{p1}/R}\right)}-j\,\dfrac{1}{\omega CR}}. \tag{12}$$

For abbreviation, let us define the following terms:

$$\omega_0 = 1/CR, \quad \text{or} \quad f_0 = \frac{\omega_0}{2\pi} = \frac{1}{2\pi RC},$$

the upper reference frequency, which is determined by the RC time constant of the resistance R and the plate-to-ground capacitance C of the driver stage.

$$\nu = \omega/\omega_0 = \frac{f}{f_0},$$

the frequency ratio,

$$N = \frac{\mu_2}{2\mu_2 + \dfrac{r_{p2}}{R}},$$

and

$$M = \frac{(1 + \mu_1 + r_{p1}/R)\left(2 + \mu_2 + \dfrac{r_{p2}}{R} + \dfrac{r_{p2}}{R_L}\right)}{\left(2 + \mu_1 + \dfrac{r_{p1}}{R}\right)\left(2 + \dfrac{r_{p2}}{R_L}\right) + 2\mu_2 + \dfrac{r_{p2}}{R_L}}. \tag{13}$$

Then the ratio of the voltage gains becomes

$$K_h/K_L = (1 + jN\nu)/(1 + jM\nu). \tag{14}$$

The magnitude of this gain ratio can be expressed in terms of decibels gain as

$$20 \log_{10} K_h/K_L = 20 \log_{10} \sqrt{1 + N^2\nu^2} - 20 \log_{10} \sqrt{1 + M^2\nu^2}, \tag{15}$$

and the phase angle is

$$\phi = \tan^{-1} N\nu - \tan^{-1} M\nu. \tag{16}$$

The factors M and N in the previous equations together with the factors A and β mentioned in Sections I and II set up a practical limitation for the choice of the circuit and tube parameters. To make the factor A reasonably small, but still seeking a sizable power output with adequate negative feedback, one would choose a large μ_1, while μ_2 and r_{p2} are kept reasonably small. Again, let $R \cong r_{p1}$ and $r_{p1} > r_{p2}$, and for a matched resistive load, (13) becomes

$$N \cong \frac{\mu_2}{2\mu_2} = \frac{1}{2}$$

$$M \cong \frac{(2 + \mu_1)\left[4 + \mu_2\left(1 + \dfrac{2}{3 + \mu_1}\right)\right]}{4(3 + \mu_1 + \mu_2)}. \tag{17}$$

It is then permissible to assign different values of μ_1 and μ_2 and calculate the range of M that is of practical interest. Fig. 5 is the plot of these calculations. It is noticed that within practical considerations r_{p2} and μ_2 should not be very large to give a small A, leaving little choice for the M value if μ_1 is to be as large as permissible.

The choice of M and N affects the frequency response of the amplifier. This can be seen from a calculation of the gain-frequency characteristic computed for different assumed values of M and N. Let $M = 1.5$, $N = 0.5$, (15) and (16) are computed and plotted as the solid-line curves in Fig. 6. The three discontinuous dotted straight-line segments are the asymtotical plots of the gain characteristic with a first break at $\nu_1 = 0.667$ and a second break at $\nu_2 = 2.0$. If f_0 is chosen as one million cps, then from Fig. 6, the amplifier shows a 2.55 decibel loss at 667 kc and a 7 decibel loss at 2 mc. At much higher frequencies, the loss will be 9.54 db. Increasing the value of M moves the first break point toward the left. Thus for $M = 2$, $N = 0.5$, the break points will be at $\nu_1 = 0.5$ and $\nu_2 = 2.0$ (dot-dash line) respectively. The amplifier will then have a loss of 2.75 db at 500 kc and 12.04 db at higher frequencies. Thus the flat portion of the gain-frequency curve is reduced. It can also be shown that reducing the value of N moves the second break point and the phase shift curve toward the right. The difference in gain between lower and higher frequencies also increases.

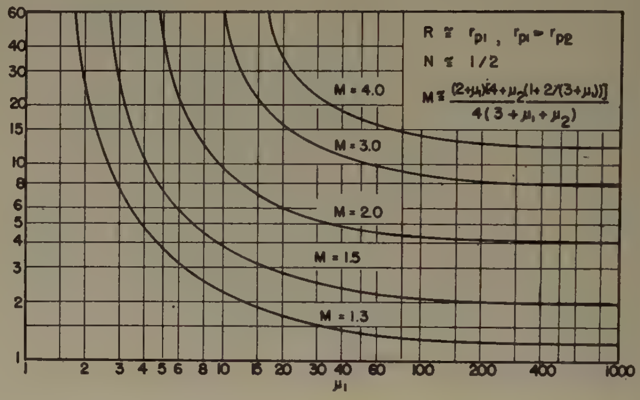


Fig. 5—Range of tube parameters for practical considerations.

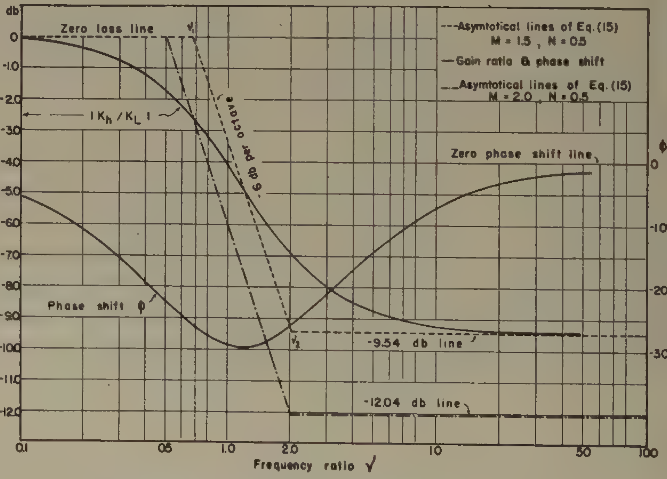


Fig. 6—Magnitude and phase of the gain ratio as a function of the frequency ratio.

EXPERIMENTAL RESULTS

Fig. 4 is the actual circuit used in the experiment. Separately adjustable biases for the power tubes were provided. With a pair of 6L6GA's as output tubes and one section of a 6SN7 as driver, maximum power output of 28 watts was obtained. For this operation, 400 volts were used for plate supply and −30 volts for the grid biases. The plate circuit efficiency thus obtained was 31%. In another operation, using −35 volts as bias, the plate efficiency increased to 35.3% with a power output of 22.7 watts. Frequency response in each case was flat to within two decibels from 30 cycles per second to 200,000 kilocycles per second. A Western Electric output transformer 134C was used in the output system for impedance matching purpose.

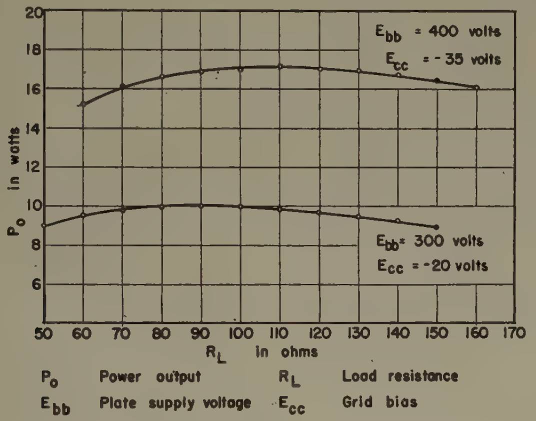


Fig. 7—Power output-load resistance curves for constant signal input.

Several experimental results are worth mentioning. Fig. 7 is a plot of the power output against load resistances for two different operating voltages. Signal input in both cases is maintained constant to a level such that practically no distortion is observed in a cathode-ray oscilloscope over the entire range of the load variation. The curves show well defined maximum at certain resistances which coincide with the values computed from one-fourth of the plate-to-plate resistance for a conventional push-pull circuit. Fig. 8 shows the variation of the driving voltage across the grid-to-cathode of the output tubes for two different operating conditions. In both cases, the driving voltages decrease as the load resistance is increased. The drooping driving voltage characteristic is the main cause for the drooping power output curve in Fig. 7 at larger load resistances. Larger output power can be obtained at these larger load resistances by increasing the input signal.

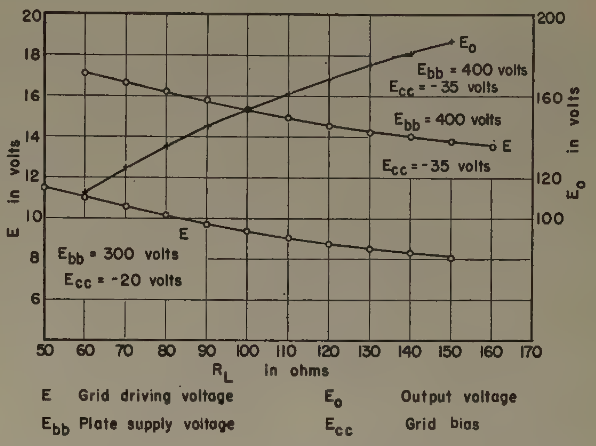


Fig. 8—Driving voltage and output voltage-load resistance.

A curve for the output voltage is also plotted along with the driving voltage. It increases with increasing load resistance. The sum of this voltage and two times the grid driving voltages constitute the total ac voltage available across the driver tube. With increasing load resistance, the re-division of the total ac voltage among the effective resistance (the output voltage) and the resistances R (the driving voltages) is the cause of these variations. As the aim of this circuit design is to obtain large output power, the condition for maintaining constant driving voltage (*small A*) mentioned in our theory is not used.

ACKNOWLEDGMENT

The author wishes to express his appreciation for the valuable discussions carried out during the course of this investigation with Professor E. L. Chaffee of Harvard University and Dr. D. B. Sinclair and Dr. A. Peterson of General Radio Company, Cambridge, Mass.

A Comparison of the Informational Capacities of Amplitude- and Phase-Modulation Communication Systems*

NELSON M. BLACHMAN†, ASSOCIATE MEMBER, IRE

Summary—**In this paper are calculated the informational capacities and the optimum statistics of communication systems consisting of an amplitude- and/or phase-modulated transmitter; a medium, which may include the rf and IF portions of the receiver, and in which white thermal noise of the same bandwidth as the transmitted signal is added to the latter; and a receiver responding to the amplitude and/or phase of this received signal. Restriction of the transmitted signal or receiver response to amplitude modulation alone or to phase modulation alone reduces the informational capacity of the system below the full channel capacity found by Shannon, $C = W \log (1+r^2)$, with W the bandwidth in cps and r the rms signal-to-noise ratio. It is found that at very high signal-to-noise ratios the capabilities of AM alone and of PM alone each account for half this full informational capacity of the channel. When the signal-to-noise ratio is much less than unity, however, PM has 79% of the full channel capacity, while AM can transmit no more than about 17% of the full channel capacity. If a receiver is used which responds to both amplitude and phase, on the other hand, the capacity at low signal-to-noise ratios equals the full channel capacity whatever type of transmitter is used. An AM signal received on a PM receiver is found to be able at low signal-to-noise ratios to convey as much information as a PM signal. When the signal-to-noise ratio becomes large, however, the informational capacity of this system is of a smaller order of magnitude than the capacities of the other systems.**

INTRODUCTION

IN A MANNER similar to that used by Shannon[1] to represent any signal limited to a frequency band of width W cps in terms of its instantaneous values at intervals of $1/2W$, we can show (Appendix A) that such a signal is representable in terms of its amplitude and phase at intervals of $1/W$. Thus, amplitude modulation is the process of keeping these phase angles constant and choosing different values for the amplitudes. The process of ascertaining these amplitudes at intervals of $1/W$ may be regarded as amplitude demodulation or AM reception. The values of these amplitudes constitute a minimum of data necessary for the reconstruction of the transmitted AM signal, since the modulating wave can contain frequencies only up to $\frac{1}{2}W$. A receiver sampling the amplitude of its input at intervals of the reciprocal of the bandwidth, though unlike any in use, is a minimal AM receiver. A system which uses any other receiver and which is capable in the absence of noise of reproducing a transmitted AM signal of the same bandwidth, must have at least as great an informational capacity in the presence of noise as has a system using this minimal receiver.

Phase modulation and PM reception may be defined similarly, and similar considerations apply to them. Only if the change in phase during every interval $1/W$ is small will the amplitude actually remain constant between sampling times. This is the case if the phase modulation is restricted to wide-band frequency modulation. Such a restriction would reduce the informational capacity of a PM system and will not be considered.

In this paper systems are considered which involve an amplitude- and/or phase-modulated transmitter whose amplitude at the sampling times is limited in peak or in mean-square value, and a receiver responding to the amplitude and/or phase of the received signal, the latter being equal to the transmitted signal plus white thermal noise of the same bandwidth. The signal transmits information at the greatest rate when optimum use is made of the freedom of its W independent amplitude values and/or W independent phase values per second, subject to the prescribed mean-square or peak amplitude. The freedom of either of these sets of parameters is described by the probability distribution of these amplitudes and/or these phases. They are assumed to be statistically independent of each other, since the signal then has the greatest freedom.

With this assumed independence of the values at successive sampling instants, there is a finite probability that the signal amplitude will attain any value, positive or negative, between sampling instants, in violation of a peak-amplitude limitation or of a restriction to non-negative values. (No violation of an average-power limitation can occur.) However, these violations will be infrequent and only rarely serious. The imposition of a condition that the amplitude should always remain within a certain range of values would thus reduce the informational capacity of a system only slightly below the values found here with such conditions imposed only at the sampling instants. Z. Jelonek has investigated this point in this detail and has also obtained independently some of the results found in the present paper.[2]

From the output of a receiver responding to both the amplitude and the phase of its input at intervals of $1/W$, it is possible to reconstruct the input (received) signal for all instants between sampling times. Since, therefore, such a receiver has complete information about its input, no system using any other receiver can

---

* Decimal classification: R148.2×R148.3. Original manuscript received by the Institute, Aug. 1, 1952; revised manuscript received Dec. 19, 1952.

† Computer Branch, Office of Naval Research, Washington, D. C.

[1] C. E. Shannon, "Communication in the presence of noise," PROC. I.R.E., vol. 37, pp. 11–21; January, 1949.

[2] Z. Jelonek, "A comparison of transmission systems," a paper presented at the Symposium on Applications of Communication Theory, Electrical Engineering Dept., Imperial College, London, September, 1952. The proceedings of this symposium are to be published by Messrs. Butterworths Scientific Press.

TABLE I

INFORMATIONAL CAPACITIES IN NITS[a] PER SECOND AND OPTIMUM STATISTCIS OF TRANSMITTED SIGNALS *vs.* R-M-S SIGNAL-TO-NOISE RATIO r FOR VARIOUS COMMUNICATION SYSTEMS OF BANDWIDTH W C.P.S.

<table>
<tr><th rowspan="2"></th><th colspan="2">System</th><th colspan="5">Capacity and Optimum Statistics of Transmitted Signal</th></tr>
<tr><th>Transmitting</th><th>Receiving</th><th>$r \ll 1$</th><th>General Case</th><th colspan="2">$r \gg 1$</th></tr>
<tr><td rowspan="2">I</td><td rowspan="2">AM and PM</td><td rowspan="2">AM and PM</td><td>Wr^2</td><td>$W \log (1+r^2)$</td><td colspan="2">$2W \log r$</td></tr>
<tr><td colspan="4">Amplitude: Rayleigh distribution.[b] Phase: Uniform probability, 0 to 2π.</td></tr>
<tr><td rowspan="2">II</td><td rowspan="2">PM or
PM and AM</td><td rowspan="2">PM</td><td>$\frac{1}{4}\pi Wr^2$</td><td>—</td><td colspan="2">$W \log (2\sqrt{\pi/e}r)$</td></tr>
<tr><td colspan="4">Phase: Uniform probability, 0 to 2π. Amplitude: Constant</td></tr>
<tr><td rowspan="2">III</td><td rowspan="2">AM or
AM and PM</td><td rowspan="2">AM</td><td>Approximately $0.17Wr^2$</td><td>—</td><td colspan="2">$W \log (r/\sqrt{2})$</td></tr>
<tr><td>Amp. $=1.05$ times r-m-s noise with probability $1.8r^2$, $=0$ the rest of the time.</td><td>Indifferent to PM.</td><td colspan="2">Amplitude: Positive normal distribution.[b]</td></tr>
<tr><td rowspan="2">IV</td><td rowspan="2">PM</td><td rowspan="2">PM and AM</td><td>Wr^2</td><td>—</td><td colspan="2">$W \log (2\sqrt{\pi/e}r)$</td></tr>
<tr><td colspan="4">Uniform probability, 0 to 2π.</td></tr>
<tr><td rowspan="2">V</td><td rowspan="2">AM</td><td rowspan="2">AM and PM</td><td>Wr^2</td><td>$\frac{1}{2}W \log (1+2r^2)$</td><td>$W \log (\sqrt{2}r)$</td><td>$W \log (r/\sqrt{2})$</td></tr>
<tr><td>Mean amp. $=0$; or amp. always either 0 or $\gg$r-m-s amplitude.</td><td>Gaussian.[b]</td><td>Gaussian.[b]</td><td>Positive normal.[b]</td></tr>
<tr><td rowspan="2">VI</td><td rowspan="2">PM</td><td rowspan="2">AM</td><td>0</td><td>0</td><td colspan="2">0</td></tr>
<tr><td colspan="4">No information can be transmitted in this case regardless of the statistics.</td></tr>
<tr><td rowspan="2">VII</td><td rowspan="2">AM</td><td rowspan="2">PM</td><td>$\frac{1}{4}\pi Wr^2$</td><td>—</td><td colspan="2">Of the order of $W \log (\sqrt{2/\pi e} \log 2r)$</td></tr>
<tr><td>Mean amp. $=0$; or amp. always either 0 or $\gg$r-m-s amplitude.</td><td>—</td><td colspan="2">Log of amplitude distributed uniformly for amplitudes between r-m-s noise level and appropriate larger value.</td></tr>
</table>

[a] One natural unit (nit) of information equals 1.443 binary units (bits).
[b] See Fig. 1.

have a higher informational capacity than one using this maximal receiver. The capacity of this latter system is, thus, a measure of the capacity of the transmitter and the channel. Similarly, the informational capacity of a system using a transmitter capable of simultaneous AM and PM is a measure of the capacity of the channel and the receiver. When such a transmitter is used with a maximal receiver (responding to both amplitude and phase), the capacity, which for this case was found by Shannon,[3] characterizes the channel alone, since it is not limited by the input or output device.

From the output of a receiver that responds continuously to the phase of its input—between as well as at the sampling times—it is possible to detect the variations of the amplitude of its input. Likewise, from the output of a receiver responding continuously to the amplitude of its input it is possible to keep track of the variations of the phase of its input. Hence, an AM or PM receiver which responds continuously, rather than at the sampling times alone, may be considered as responding to both the amplitude and phase of its input—if the fullest use is made of the information available from it. The informational capacity of a system using a real receiver must, thus, lie somewhere between that of a system using a minimal receiver (AM or PM) and that of a system using a maximal receiver, responding to both amplitude and phase.

In the present computations, synchronization has been assumed between the sampling at the transmitter and the receiver. Synchronization does not affect the capacity of a system using a maximal receiver. However, when the receiver responds only to amplitude or to phase, a loss in informational capacity would result from failure to synchronize, because the statistics of the transmitted signal are optimized for the transmitter's sampling instants.

RESULTS

A channel can carry the greatest amount of information per second when the transmitter and receiver both use AM and PM simultaneously. The capacity for this case under an average-power limitation was found by Shannon,[3] viz., $C = W \log (1+r^2)$, with W the bandwidth in cps and r the ratio or rms signal to rms noise. It will be referred to as the "full channel capacity." Shannon showed that this capacity is realized by using transmitted-signal statistics identical with white thermal noise of bandwidth W, viz., a uniform distribution of phase angles and a Rayleigh distribution of the amplitudes at the sampling times as shown in Fig. 1.

This capacity and these statistics are shown in line I of Table I, which presents the capacities and optimum statistics in the case of an average-power limitation on the transmitted signal. These capacities are graphed in Fig. 3. In most cases it has been possible to carry through the analysis only for extreme values of the rms signal-to-noise ratio r. Hence, the table is divided into three parts—for small, large, and general r.

---

[3] C. E. Shannon, "A mathematical theory of communication," *Bell Sys. Tech. Jour.*, vol. 27, pp. 379–423, 623–656; July and October, 1948.

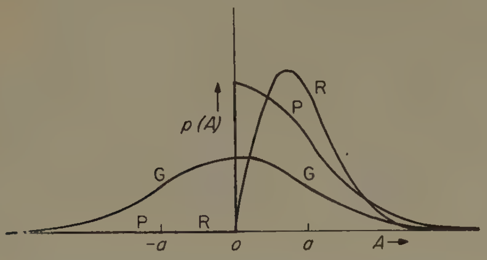


Fig. 1—G: Gaussian distribution, $p(A)=e^{-A^2/2a^2}/\sqrt{2\pi}a$.
P: Positive normal distribution, $p(A)=e^{-A^2/2a^2}/\sqrt{\frac{1}{2}\pi}a$, $A\geqq 0$.
R: Rayleigh distribution, $p(A)=(2A/a^2)e^{-A^2/a^2}$, $A\geqq 0$.

The results in the case of a peak-power limitation are shown in Table II and Figs. 2 and 4 in terms of s, the ratio of peak signal amplitude to rms noise amplitude. "Overmodulatable" is used to describe an AM transmitter capable of emitting negative amplitudes, *i.e.*, of reversing the phase of its output. The two entries on line V of Table I for large r refer to an overmodulatable and non-overmodulatable transmitter, respectively; the entry for general r applies to the former only. All of the results are expressed in nits per second, one nit being 1.443 ($=\log_2 e$) bits, since natural logarithms have been used in the computations.

Looking at Tables I and II and comparing lines I, II, and III, we see that at high signal-to-noise ratios the AM and PM capacities are each half the full channel capacity. At low signal-to-noise ratios, the PM capacity is 79% of the full channel capacity, but the AM capacity never exceeds 17%. Under a peak-power limitation, in fact, the AM capacity is of a lower order of magnitude for small s. Turning to lines IV and V of the tables, we see that at low signal-to-noise ratios the capacity of a system using a receiver responsive to both amplitude and phase equals the full channel capacity, whether an AM or a PM transmitter is used.

The optimum distribution for the phase θ or a PM transmitter is found to be flat from 0 to 2π, with all values equally likely. The important consideration at low signal-to-noise ratios, however, is that this distribution have no Fourier first-harmonic content, *i.e.*, that the mean values of $\sin\theta$ and $\cos\theta$ should both be zero.

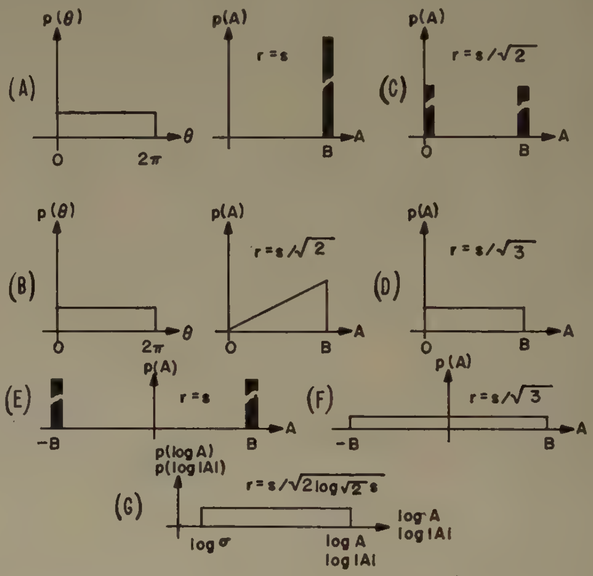


Fig. 2—Distributions of amplitude A and phase θ of transmitted signal. B = peak amplitude.

As the signal-to-noise ratio increases, the higher harmonics become successively effective in depressing the rate of transmission of information.

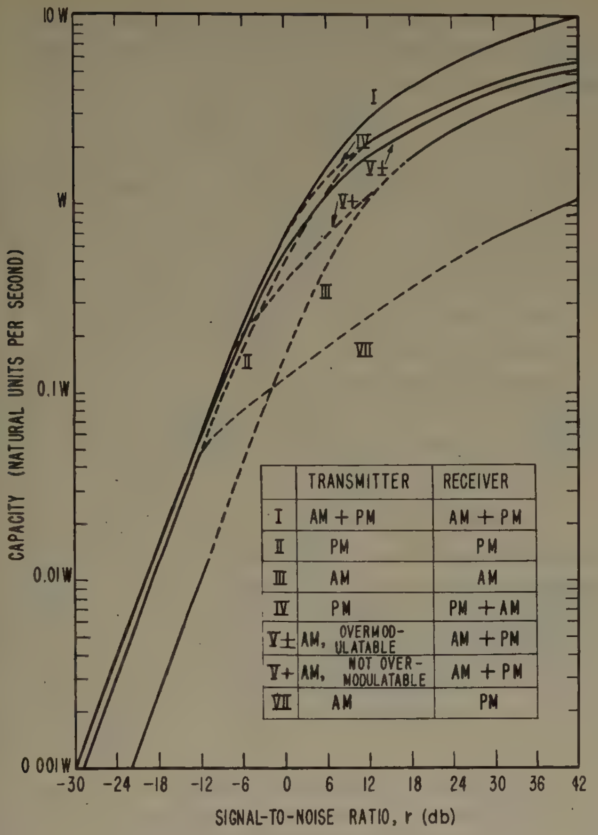
In the case of an AM transmitter under an average-power limitation being received on a PM receiver or on a maximal receiver, whether the transmitter can be

TABLE II

Informational Capacities in Nits[a] per Second and Optimum Statistics of Transmitted Signals *vs.* Peak-Signal-to-RMS-Noise Ratio s for Various Communication Systems of Bandwidth W cps

	System		Capacity and Optimum Statistics			
	Transmitting	Receiving	$s\ll 1$		$s\gg 1$	
I	AM and PM	AM and PM	Ws^2	(e.g., A)	$2W\log(\sqrt{(2/e)}s)$	(B)
II	PM or PM and AM	PM	$(\pi/4)Ws^2$	(e.g., A)	$W\log(2\sqrt{(\pi/e)}s)$	(A)
III	AM or AM and PM	AM	$\frac{1}{8}Ws^4$	(C)	$W\log(s/\sqrt{\pi e})$	(D)
IV	PM	PM and AM	Ws^2	(e.g., A)	$W\log(2\sqrt{\pi/e}s)$	(A)
V+	AM, not over-modulatable	AM and PM	$\frac{1}{4}Ws^2$	(C)	$W\log(s/\sqrt{\pi e})$	(D)
V±	AM, over-modulatable	AM and PM	Ws^2	(E)	$W\log(2s/\sqrt{\pi e})$	(F)
VI	PM	AM	0		0	
VII+	AM, not over-modulatable	PM	$(\pi/16)Ws^2$	(C)	$W\log[\sqrt{2/\pi e}\log(\sqrt{2}s)]$	(G_1)
VII±	AM, over-modulatable	PM	$(\pi/4)Ws^2$	(E)	$W\log[\sqrt{8/\pi e}\log(\sqrt{2}s)]$	(G_2)

[a] One natural unit (nit) equals 1.443 binary units (bits).
$A-G_2$. See Fig. 2.



	TRANSMITTER	RECEIVER
I	AM + PM	AM + PM
II	PM	PM
III	AM	AM
IV	PM	PM + AM
V±	AM, OVERMODULATABLE	AM + PM
V+	AM, NOT OVERMODULATABLE	AM + PM
VII	AM	PM

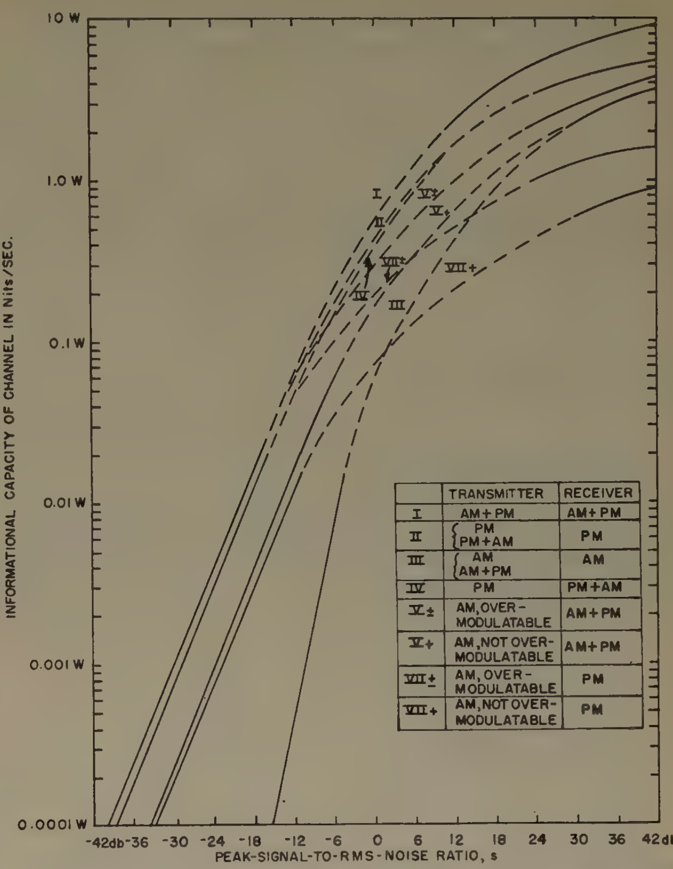
Fig. 3—Informational capacity *vs.* RMS signal-to-noise ratio for various communication systems. The solid curves are plotted from Table I; the dashed portions are interpolated by eye.

overmodulated or not, the essential characteristic of the optimum distribution of transmitted amplitudes at low signal-to-noise ratios is the smallness of their mean value. This mean amplitude is the amplitude of the carrier. Hence, if r is small or if the transmitter is overmodulatable, the transmitted power is better used the less of it that is expended on the carrier.

Another interesting result is found in line VII of the tables. At low signal-to noise ratios, an AM signal is able to transmit to a PM receiver as much information as a PM signal can. When the signal-to-noise ratio is large, however, the informational capacity of the system is of a lower order of magnitude than those of other systems. Looking at line VI of the tables, we see that with the definitions we are using, a PM signal can convey no information at all to a minimal AM receiver.

Detailed examination of the tables discloses some paradoxes. By way of example, we may consider some of those found in Table I. The sum of lines II and III for large r exceeds the full channel capacity (line I) by $0.44W$ nits per second. However, the capacity of the channel for PM transmission (line II) is reduced by the amplitude modulation specified in line III by $0.64W$ nits per second, since the log r in the expression for the PM capacity must be averaged over the amplitude distribution, r being no longer constant.

Thus, PM and AM together appear at high signal-to-noise ratios to fall short of the full channel capacity by $0.20W$ nits per second. The reason is that the amplitude distribution we are considering has been chosen to maximize the AM rate of transmission of information without regard for its effect on the PM rate. A Rayleigh distribution of the transmitted amplitudes maximizes the sum of the AM and PM rates, bringing it exactly to the value and situation of line I.



	TRANSMITTER	RECEIVER
I	AM+PM	AM+PM
II	PM PM+AM	PM
III	AM AM+PM	AM
IV	PM	PM+AM
V±	AM, OVER-MODULATABLE	AM+PM
V+	AM, NOT OVER-MODULATABLE	AM+PM
VII±	AM, OVER-MODULATABLE	PM
VII+	AM, NOT OVER-MODULATABLE	PM

Fig. 4—Informational capacity *vs.* peak-signal-to-rms-noise ratio for various communication systems. The solid curves are plotted from Table II; the dashed portions are interpolated by eye.

When r is small, the PM capacity is not affected by amplitude modulation of the transmitted signal. However, the sum of the AM and PM capacities (lines II and III) is now only about 96% of the full channel capacity. The missing 4% or so represents the correlation implied by the received signal between the a posteriori distributions of the phase and amplitude of the transmitted signal. This correlation information is lost when phase and amplitude must be described separately.

Comparison of lines I, IV, and V of Table I reveals a sum of PM and AM capacities exceeding the full channel capacity. No contradiction is involved since the capacity in line V, for example, depends upon the advance knowledge that the phase of the transmitted AM signal is always zero. This will not hold when AM and PM are employed in the same transmitter.

Appendix A. Amplitude-and-Phase Description of Signal

If the bandwidth W occupied by a signal is small compared to the center frequency F of the band, the signal $s(t)$ has at any time a definite amplitude $A(t)$ and phase $\theta(t)$, in terms of which $s(t) = \text{Re } A(t)e^{2\pi jFt+j\theta(t)}$.

According to the Fourier integral theorem, we can express $s(t)$ as the real part of the complex function

$$s_c(t) = \int_{F-(1/2)W}^{F+(1/2)W} S(f)e^{2\pi ift}df, \tag{A-1}$$

whence we see that $s_c(t) = A(t)e^{2\pi jFt+j\theta(t)}$. Because of its finite spread in frequency, we can write $S(f)$, the Fourier transform of $s_c(t)$, as a Fourier series;

$$S(f) = \sum_n S_n e^{-2\pi jnf/W}, \tag{A-2}$$

with the coefficients

$$S_n = \frac{1}{W}\int_{F-(1/2)W}^{F+(1/2)W} S(f)e^{2\pi jnf/W}df. \tag{A-3}$$

From (A-1), we see that (A-3) reduces to $S_n = s_c(n/W)/W$, which we substitute into (A-2). Substituting (A-2), into (A-1), now, we get

$$\begin{aligned} s_c(t) &= \frac{1}{W}\sum_n s_c(n/W)\int_{F-(1/2)W}^{F+(1/2)W} e^{2\pi jf(t-n/W)}df \\ &= \sum_n s_c(n/W)e^{2\pi jF(t-n/W)}\frac{\sin \pi(Wt-n)}{\pi(Wt-n)} \\ &= \sum_n A(n/W)e^{2\pi jFt+j\theta(n/W)}\frac{\sin \pi(Wt-n)}{\pi(Wt-n)}. \end{aligned} \tag{A-4}$$

Hence,

$$s(t) = \sum_n A(n/W)\frac{\sin \pi(Wt-n)}{\pi(Wt-n)}\cos\left[2\pi Ft+\theta(n/W)\right]. \tag{A-5}$$

This expression clearly takes on amplitude $A(n/W)$ and phase $\theta(n/W)$ at time n/W.

Thus, we see that the signal is completely determined by the values of its amplitude and phase at intervals of $1/W$. There are W pairs of these values per second, all of which are completely independent of each other. For the complete description of a signal of duration T, we thus have $2WT$ necessary and sufficient parameters.

APPENDIX B. SIGNAL STATISTICS

From Appendix A we see that the informational capacity of a system, the largest amount of information that it can transmit per second, is W times the mean amount of information that it can transmit at one sampling instant. The latter is the maximum possible value of the mean amount of information given about the transmitted signal by whatever characteristics of the received signal the receiver responds to. This mean amount of information is the difference between the entropy per sample of those characteristics of the received signal and their conditional entropy—their entropy per sample for a given transmitted signal, averaged over all possible transmitted signals. (We shall henceforth abbreviate "entropy per sample" to "entropy.")

To determine these entropies, we need the statistics connecting the received signal with the transmitted. These signals will be described by the following symbols:

A = amplitude of transmitted signal,
θ = phase of transmitted signal,
V = amplitude of received signal (transmitted signal plus white thermal noise of equal bandwidth),
ϕ = phase of received signal,
W = bandwidth in cps of communication channel,
a = rms value of A, $a = \sqrt{2}$ times rms transmitted signal voltage,
σ = rms noise voltage,
$r = a/\sqrt{2}\sigma$ = rms signal-to-noise ratio,
B = largest allowed magnitude of A,
$s = B/\sqrt{2}\sigma$ = peak-signal-to-rms-noise ratio ($s \geqq r$).

Under an average-power limitation or, equivalently, an rms-amplitude limitation, the transmitted amplitude A is limited to an rms value which we shall call a. The rms signal voltage is, thus, $a/\sqrt{2}$, so that with rms noise voltage σ, the ratio of rms signal to rms noise is $r = a/\sqrt{2}\sigma$. Under a peak-power limitation or, equivalently, a peak-amplitude limitation, A is limited in magnitude to the value which we shall call B. With rms noise voltage σ, the rms noise amplitude is $\sqrt{2}\sigma$. The ratio of the peak transmitted amplitude to the rms noise amplitude is, thus, $s = B/\sqrt{2}\sigma$. Since the rms value of A cannot exceed its peak value, we have $r \leqq s$.

We may write the transmitted signal as $A \cos (2\pi Ft + \theta)$, the noise as $x \cos 2\pi Ft - y \sin 2\pi Ft$, and their sum, the received signal, as $(A \cos \theta + x) \cos 2\pi Ft - (A \sin \theta + y) \sin 2\pi Ft = V \cos (2\pi Ft + \phi)$. The values of x and y at the sampling instants are completely uncorrelated and obey the Gaussian distribution with zero mean and standard deviation equal to σ, the r-m-s noise voltage;[4]

$$p(x, y)dxdy = \frac{1}{2\pi\sigma^2}e^{-(x^2+y^2)/2\sigma^2}dxdy. \tag{B-1}$$

Since $V \cos \phi = A \cos \theta + x$ and $V \sin \phi = A \sin \theta + y$, we have, solving for x and y and substituting into (B-1), and replacing the element of area $dxdy$ by the element $Vd\phi dV$, the distribution of ϕ and V:

$$p_{\theta A}(\phi, V)d\phi dV = \frac{V}{2\pi\sigma^2}e^{-[A^2+V^2-2AV\cos(\phi-\theta)]/2\sigma^2}d\phi dV. \tag{B-2}$$

The subscripts indicate this is the conditional distribution of ϕ and V for assigned values of θ and A.

Integrating (B-2) with respect to ϕ from 0 to 2π, we get the conditional distribution of V,

$$p_{\theta A}(V)dV = \frac{V}{\sigma^2}e^{-(A^2+V^2)/2\sigma^2}I_0(AV/\sigma^2)dV, \tag{B-3}$$

in which I_0 is a modified Bessel function of the first kind. Integrating (B-2) instead with respect to V from

---

[4] S. O. Rice, "Mathematical analysis of random noise," *Bell Sys. Tech. Jour.*, vol. 24, pp. 46–156; January, 1945.

0 to ∞, we get the conditional distribution of ϕ,

$$p_{\theta A}(\phi)d\phi = \left[\frac{1}{2\pi}\, e^{-A^2/2\sigma^2} + \frac{A}{\sqrt{2\pi}\sigma} \cos\,(\phi-\theta) e^{-(A^2/2\sigma^2)\sin^2(\phi-\theta)} \right.$$
$$\left. \mathrm{Erf}\left(\frac{A}{\sigma} \cos\,[\phi-\theta]\right)\right] d\phi, \quad \text{(B-4)}$$

the error function being defined as

$$\mathrm{Erf}(x) = \int_{-\infty}^{x} e^{-x^2/2} dx/\sqrt{2\pi}.$$

When the signal-to-noise ratio is large, we may substitute the asymptotic expression for the Bessel function into (B-3), getting

$$p_{\theta A}(V)dV = \frac{1}{\sqrt{2\pi}\sigma} e^{-(V-A)^2/2\sigma^2} dV. \quad \text{(B-5)}$$

When the signal-to-noise ratio is large, the first term of (B-4) becomes negligible, the error function is approximately unity, because $|\phi-\theta| \ll 1$, and the sine may be replaced by its argument, giving us

$$p_{\theta A}(\phi)d\phi = \frac{A}{\sqrt{2\pi}\sigma} e^{-A^2(\phi-\theta)^2/2\sigma^2} d\phi. \quad \text{(B-6)}$$

If, on the other hand, we were to substitute the first two terms of its power series for the cosine into (B-2), we would find that it factored approximately into the product of (B-5) times (B-6), showing that when the signal-to-noise ratio is large, the received amplitude and phase are statistically independent of each other, the first being distributed normally about the transmitted amplitude with standard deviation σ, and the second being distributed normally about the transmitted phase with standard deviation σ/A.

When the signal-to-noise ratio is small, the error function in (B-4) is approximately $\frac{1}{2}$, and (B-4) becomes

$$p_{\theta A}(\phi)d\phi = \left[1 + \sqrt{\frac{\pi}{2}}\, \frac{A}{\sigma} \cos\,(\phi - \theta)\right] \frac{d\phi}{2\pi} \cdot \quad \text{(B-7)}$$

A more accurate approximation to the conditional distribution of ϕ for small signal-to-noise ratio is obtained directly from (B-2) by expanding exp $[AV \cos\,(\phi-\theta)/\sigma^2]$ in a power series before integrating with respect to V. The result is

$$p_{\theta A}(\phi)d\phi = \left[1 + \sqrt{\frac{\pi}{2}}\, \frac{A}{\sigma} \cos\,(\phi - \theta) \right.$$
$$+ \frac{A^2}{1\sigma^2} \cos^2\,(\phi - \theta)$$
$$+ \sqrt{\frac{\pi}{2}}\, \frac{A^3}{2\sigma^3} \cos^3\,(\phi - \theta)$$
$$+ \frac{A^4}{1\cdot 3\sigma^4} \cos^4\,(\phi - \theta)$$
$$+ \sqrt{\frac{\pi}{2}}\, \frac{A^5}{2\cdot 4\sigma^5} \cos^5\,(\phi - \theta)$$
$$+ \frac{A^6}{1\cdot 3\cdot 5\sigma^6} \cos^6\,(\phi - \theta)$$
$$+ \sqrt{\frac{\pi}{2}}\, \frac{A^7}{2\cdot 4\cdot 6\sigma^7} \cos^7\,(\phi - \theta)$$
$$\left. + \cdots \right] e^{-A^2/2\sigma^2} d\phi/2\pi. \quad \text{(B-8)}$$

Appendix C. Phase Modulation

Signal-to-noise ratio large

The conditional entropy of ϕ when the signal-to-noise ratio is large is by definition the mean value of minus the logarithm of (B-6) (without the $d\phi$). Thus, multiplying (B-6) by minus its logarithm and integrating from 0 to 2π, we get for the conditional entropy of ϕ

$$H_{\theta A}(\phi) = \frac{1}{2} - \log \frac{A}{\sqrt{2\pi}\sigma} \cdot \quad \text{(C-1)}$$

Because θ drops out on integrating with respect to ϕ, it is not necessary to average the result over θ.

A single value of ϕ conveys an average amount of information equal to the entropy of ϕ, $H(\phi)$, minus the conditional entropy of ϕ, $H_{\theta A}(\phi)$. It is largest when $H(\phi)$ is maximum, viz., when ϕ is distributed uniformly from 0 to 2π. This distribution of ϕ is effected by distributing θ uniformly from 0 to 2π. Subtracting (C-1) from this value and multiplying by W, the number of independent ϕ values per second, we thus obtain for the capacity of a PM channel at high signal-to-noise ratio

$$C_{PM} = W \log \sqrt{\frac{2\pi}{e}}\, \frac{A}{\sigma}$$
$$= W \log 2\sqrt{\pi/e}\, r$$
$$= W \log 2\sqrt{\pi/e}\, s. \quad \text{(C-2)}$$

Because the transmitted amplitude A is constant for a PM transmitter, it does not matter whether an average- or a peak-power limitation is imposed; $r = s$. We shall express our results in terms of r as for an average-power limitation, but they will also be correct for a peak-power limitation if r is replaced by s.

Signal-to-noise ratio small

To obtain the channel capacity correct to terms of the order of Wr^2, it suffices to use (B-7), but for greater accuracy, we must use (B-8). In writing its logarithm for the bracket it is convenient to use the series

$$\log\,(1 + u) = u - \tfrac{1}{2}u^2 + \tfrac{1}{3}u^3 - \tfrac{1}{4}u^4 + \cdots . \quad \text{(C-3)}$$

Multiplying (B-8) by minus its logarithm, expressed in this manner, we obtain $H_{\theta A}(\phi)$ by integrating with respect to ϕ from 0 to 2π, whereupon θ drops out, and

$$H_{\theta A}(\phi) = \log 2\pi - \frac{\pi A^2}{8\sigma^2} + (\pi - \tfrac{1}{8}\pi^2 - 1)\frac{A^4}{16\sigma^4} - \cdots. \tag{C-4}$$

To get $H(\phi)$, we must first obtain from (B-7) or (B-8) the (unconditional) distribution of ϕ, $p(\phi)$, by averaging over all values of θ, each with its probability $p(\theta)d\theta$. Using a bar over a function of θ to denote its mean value—the integral from 0 to 2π of $p(\theta)d\theta$ times the function—we get $p(\phi)$ simply by expanding the cosine of the difference and placing bars over the expressions of the form $\cos^m \theta \sin^n \theta$. Proceeding exactly as in finding the conditional entropy, from (B-7)

$$H(\phi) = \log 2\pi - \frac{\pi A^2}{8\sigma^2}(\overline{\cos\theta}^2 + \overline{\sin\theta}^2). \tag{C-5}$$

Subtracting (C-4) from (C-5) and multiplying by W, we find that to terms of the order of Wr^2 the rate of transmission of information is

$$R_{PM} = \tfrac{1}{4}\pi W r^2(1 - \overline{\cos\theta}^2 - \overline{\sin\theta}^2). \tag{C-6}$$

(Notice that R_{PM} vanishes if θ is constant.) The maximum value of this rate, the channel capacity, is realized when $\overline{\cos\theta} = \overline{\sin\theta} = 0$, i.e., when $p(\theta)$ has no Fourier first-harmonic content. Such is the case, for example, when θ takes on either of the values 0 or π with probability $\frac{1}{2}$. The channel capacity is, thus $C_{PM} = \frac{1}{4}\pi W r^2$.

To terms of the order of Wr^4, the rate of transmission of information when $p(\theta)$ has no first-harmonic component is

$$R_{PM} = \tfrac{1}{4}\pi W r^2 - \tfrac{1}{4}W r^4(\pi - \tfrac{1}{8}\pi^2 - 1 + \overline{\cos 2\theta}^2 + \overline{\sin 2\theta}^2) + \cdots. \tag{C-7}$$

This rate is maximized by eliminating the second-harmonic content as well, the maximum being

$$C_{PM} = \tfrac{1}{4}\pi W r^2 - \tfrac{1}{4}(\pi - \tfrac{1}{8}\pi^2 - 1)W r^4, \tag{C-8}$$

to terms of the order of Wr^4.

Succeeding terms of (C-7) will involve successive higher harmonics and will likewise be maximum when the respective harmonic contents vanish. Thus, when r is finite, the optimum $p(\theta)$ is constant.

The effect of AM

If the amplitude A of the transmitted signal is not constant, the foregoing results must be averaged over the distribution of A. If the mean-square value of A is not changed, terms in r^2, which we have written for $A^2/2\sigma^2$, will be unaffected, although terms of smaller order, which for small r may be neglected, will be increased in magnitude.

For large r, on the other hand, the capacity (C-2) will be reduced by the mean value of $W \log a/A$ if a is not altered. If A obeys the "positive normal" distribution, this reduction amounts to

$$\sqrt{\frac{2}{\pi}}\,\frac{W}{a}\int_0^\infty e^{-A^2/2a^2}\log\frac{a}{A}\,dA$$

$$= -\frac{1}{2}W\int_0^\infty e^{-u}\log 2u\,du/\sqrt{\pi u}.$$

This integral can be evaluated in terms of $\Psi(\frac{1}{2}) = -C - 2$, where Ψ is the logarithmic derivative of the gamma function, and $C = 0.5772$ is Euler's constant. Thus, ths loss of channel capacity due to AM is $\frac{1}{2}(C + \log 2)W = 0.635\,W$ nits per second.

With a Rayleigh distribution of A, there is a loss of

$$\frac{2W}{a^2}\int_0^\infty A e^{-A^2/a^2}\log\frac{a}{A}\,dA$$

$$= -\frac{1}{2}W\int_0^\infty e^{-v}\log v\,dv = \frac{1}{2}CW,$$

which amounts to only 0.289 W nits per second. This result is obtained by recognizing the integral as $\Psi(1) = -C$.

Since when r is large, any variation of the amplitude of the transmitted PM signal subject to a fixed a reduces its ability to transmit information, while when r is small it reduces the capacity by a small fraction, we infer that any amplitude modulation of the transmitted PM signal can only reduce the rate of transmission of information. This reduction will be even greater with a peak-power limitation, where a decreases if A is not constant. It is, therefore, undesirable, even if feasible, to introduce amplitude modulation on a PM signal.

APPENDIX D. AMPLITUDE MODULATION

Signal-to-noise ratio large

As Eq. (B-5) indicates, when the signal-to-noise ratio is large, the received amplitude equals the transmitted amplitude plus a Gaussian noise component of zero mean value. Shannon has shown[3] that under these circumstances the received amplitude can convey the greatest amount of information, subject to an average-transmitted-power limitation, when it too obeys a Gaussian distribution with its peak at zero. Because V cannot take on negative values, its optimum distribution is the positive normal distribution.

The restriction to non-negative values simply results in a loss of one bit of information for each independent signal amplitude from the otherwise attainable maximum found by Shannon,[3] viz., $\frac{1}{2}\log(1 + a^2/\sigma^2) \approx \log\sqrt{2}r$. Thus, subtracting log 2 and multiplying by W, we get for the AM capacity

$$C_{AM} = W \log r/\sqrt{2} \tag{D-1}$$

for large r. This capacity is realized by making $p(A)$ positive normal, since, for large r, $p(V)$ differs little from $p(A)$.

Similarly, under a peak-power limitation, such as $0 \leqq A \leqq B$, the rate of transmission of information is approximately maximized, for large s, by maximizing the entropy of the transmitted amplitude. The maximum is effected by a uniform distribution of A over all permissible values. Thus, the entropy of the received amplitude is approximately $\log B$, because $p(A)$ and

$p(V)$ cannot differ very much. Subtracting the conditional entropy—the entropy of the (in-phase component of the) noise—$\log \sqrt{2\pi e}\sigma$ and multiplying by W, we get for large s

$$C_{AM} = W \log s/\sqrt{\pi e}. \tag{D-2}$$

Signal-to-noise ratio small

The conditional entropy of V, $H_A(V)$, is the mean value of $-\log p_A(V)$, with $p_A(V)$ given by (B-3). The term $-\log (Ve^{-V^2/2\sigma^2})$, which will be canceled out on subtraction from $H(V)$, need not be dealt with further. The remainder of $-\log p_A(V)$ is $(A^2/2\sigma^2) - \log I_0(AV/\sigma^2)$. I_0 may be expanded in a power series in A^2V^2/σ^4 and its logarithm expressed by (C-3). Averaging the resulting series over V with A fixed, and then putting bars over the powers of A to indicate the average over the distribution of A, we find that

$$H_A(V) = -\langle \log (Ve^{-V^2/2\sigma^2})\rangle_{Av} - \frac{\overline{A^4}}{8\sigma^4} + \frac{\overline{A^6}}{24\sigma^6} - \frac{3\overline{A^8}}{128\sigma^8} + \frac{7\overline{A^{10}}}{320\sigma^{10}} - \cdots. \tag{D-3}$$

$\overline{A^{2n}}$ is the $2n$-th moment of the distribution of A. The averaging over V above is accomplished simply by replacing V^2 by $2\sigma^2+A^2$, V^4 by $8\sigma^4+8A^2\sigma^2+A^4$, V^6 by $48\sigma^6+72A^2\sigma^4+18A^4\sigma^2+A^6$, V^8 by $384\sigma^8+768A^2\sigma^6 \cdots$, V^{10} by $2304\sigma^{10}+\cdots$.[4]

The entropy of V, $H(V)$, it the mean value of $-\log p(V)$. To obtain $p(V)$, we must average (B-3) over the distribution of A. This is done by multiplying the power series for $I_0(AV/\sigma^2)$ by the power series for $^{-A^2}/2\sigma^2$ and placing bars over the powers of A in the resulting power series. Using (C-3) to express the logarithm of this series and averaging first over V with A fixed, then over A, as before, we find that

$$H(V) = -\langle \log (Ve^{-V^2/2\sigma^2})\rangle_{Av} - \frac{\overline{A^2}^2}{8\sigma^4} + \frac{\overline{A^2}^3}{24\sigma^6} - \frac{\overline{A^4}^2 - 4\overline{A^2}^2\,\overline{A^4} + 6\overline{A^2}^4}{8\sigma^8} + \cdots. \tag{D-4}$$

Subtracting (D-3) from (D-4) and multiplying by W, we obtain the rate of transmission of information over an AM channel,

$$R_{AM} = W\left(\frac{\overline{A^4} - \overline{A^2}^2}{8\sigma^4} - \frac{\overline{A^6} - \overline{A^2}^3}{24\sigma^6} + \frac{3\overline{A^8} - \overline{A^4}^2 + 4\overline{A^2}^2\,\overline{A^4} - 6\overline{A^2}^4}{128\sigma^8} - \frac{7\overline{A^{10}} - 5\overline{A^2}\,\overline{A^4}^2 + 20\overline{A^2}^3\,\overline{A^4} - 22\overline{A^2}^5}{320\sigma^{10}} + \cdots\right). \tag{D-5}$$

(Notice that each term of R_{AM} vanishes if A is constant.)

The lack of a term in (D-5) of the order of Wr^2 means that if $p(A)$ does not depend on σ, or if A cannot exceed some prescribed value, the rate of transmission of information over an AM channel is of a smaller order of magnitude for small signal-to-noise ratio than is the rate for any other usable system. This lack is due to the fact that $p_A(V)$, when expanded as a power series in A, has no term in the first power of A. The influence of A on the distribution of V first appears in a term in A^2, while in the other communication systems the distribution of the significant parameters of the received signal contains a term in the first power of the modulation. This smallness of the influence of A on the distribution of V, in turn, is essentially due to the non-negative character of V; if A took on the value $-A$, the distribution of V would not change at all. Thus, the latter must depend on the square of A. The integral with respect to V from 0 to ∞ of the term in A^2 must vanish because $\int_0^\infty p_A(V)dV = 1$ regardless of the value of A. Hence, this term cannot yield a term in A^2 in the entropy, and thus (D-5) is of the order of A^4.

Subject to the condition that $0 \leqq A \leqq B$, the leading term of (D-5) is greatest when the distribution of A is such that the values 0 and B each have probability $\frac{1}{2}$. To terms of the order of Ws^4, then,

$$C_{AM} = \tfrac{1}{8}Ws^4. \tag{D-6}$$

When an average-power limitation is imposed, we find that the leading term of (D-5) can be made arbitrarily large by having A take on the value 0 with high probability and some arbitrarily high value D with correspondingly low probability, so as to keep $\overline{A^2} = a^2$. Beyond a certain value, however, the second term of (D-5) begins to reduce R_{AM} faster than the first increases it. Such considerations determine an optimum value for D.

If A takes on the value D with probability a^2/D^2 and the value 0 with the complementary probability, (D-5) becomes

$$R_{AM} = \tfrac{1}{4}Wr^2\left(\frac{D^2}{\sigma^2} - \frac{D^4}{3\sigma^4} + \frac{3D^6}{16\sigma^6} - \frac{7D^8}{40\sigma^8} + \cdots\right) \tag{D-7}$$

plus terms of the order of r^4, etc., which are negligible for small r. (D-7) is maximum when $D = 1.05\sigma$. Thus, A should take on this value with probability $1.82r^2$ and the value 0 the remainder of the time. Under these conditions, (D-7) becomes

$$C_{AM} = 0.173Wr^2. \tag{D-8}$$

The signal-to-noise ratio at the instants when $A = 1.05\sigma$ is 0.74, for which far more terms of (D-7) are actually needed to obtain an answer as accurate as is indicated here. (Indeed the question of the convergence of our series remains open, although they must in every case be the correct Taylor series.) However, these results should be at least qualitatively correct, and (D-8) falls safely below the difference between (C-8) and the full channel capacity for small r.

Any phase modulation of the transmitted signal will, of course, have no effect on the amplitude of the received signal and, hence, no effect on the capacity of an AM system.

Appendix E. PM Transmission with Receiver Responsive Both AM and PM

Signal-to-noise ratio large

As we saw in Appendix B, the received amplitude is uncorrelated with the transmitted phase when the signal-to-noise ratio is large. The ability of the receiver to respond to V as well as to ϕ, therefore, does not increase its capacity to receive information from a PM transmitter beyond the capabilities of an ordinary PM system when r is large.

Signal-to-noise ratio small

The conditional) entropy of ϕ and V, $H_\theta(\phi V)$, is the mean value of $-\log p_{\theta A}(\phi, V)$, with $p_{\theta A}(\phi, V)$ given by (B-2). The last term of this negative logarithm is $-(AV/\sigma^2)\cos(\phi-\theta)$. We average it first over V and ϕ, noting that $V\cos(\phi-\theta)$ is the component of the "vector" (complex number) sum of the transmitted signal plus noise in the direction of the "vector" of length A representing the transmitted signal. Since the mean value of the noise component in any particular direction is zero, the mean value of $V\cos(\phi-\theta)$ must be A, which is constant for a PM transmitter. Thus,

$$H_\theta(\phi, V) = -\left\langle \log\left[\frac{V}{2\pi\sigma^2}e^{-(A^2+V^2)/2\sigma^2}\right]\right\rangle_{Av} - \frac{A^2}{\sigma^2}. \qquad \text{(E-1)}$$

The (unconditional) distribution of ϕ and V, $p(\phi, V)$, is the average of (B-2) over θ. We obtain an expression for this average by expanding the $_e(AV/\sigma^2)\cos(\phi-\theta)$ in a power series, expanding the cosine of the difference, and putting bars over the terms of the form $\cos^m\theta \sin^n\theta$ to indicate their values averaged over the distribution $p(\theta)$. Thus,

$$\begin{aligned} p_A(\phi, V) = {} & \frac{V}{2\pi\sigma^2}e^{-(A^2+V^2)/2\sigma^2} \\ & \cdot\left[1 + \frac{AV}{\sigma^2}(\overline{\cos\theta}\cos\phi + \overline{\sin\theta}\sin\phi)\right. \\ & + \frac{A^2V^2}{2!\sigma^4}(\overline{\cos^2\theta}\sin^2\phi \\ & + 2\,\overline{\cos\theta\sin\theta}\cos\phi\sin\phi \\ & \left. + \overline{\sin^2\theta}\sin^2\phi) + \cdots\right]. \end{aligned} \qquad \text{(E-2)}$$

To get the entropy of ϕ and V, $H(\phi, V)$, we use (C-3) to express the logarithm of the bracket in (E-2). We average it over V and ϕ by noting in the same way as above that the mean values of $V\cos\phi$ and $V\sin\phi$ are, respectively, $A\cos\theta$ and $A\sin\theta$. The mean-square value of each of these quantities is σ^2 plus the square of its mean. The mean value of $V^2\cos\phi\sin\phi$ is $A^2\cos\theta\sin\theta$, which is of a smaller order of magnitude and may be ignored. In this way, we find on averaging the result over θ that

$$\begin{aligned} H(\phi, V) = {} & -\left\langle \log\left[\frac{V}{2\pi\sigma^2}e^{-(A^2+V^2)/2\sigma^2}\right]\right\rangle_{Av} \\ & - \frac{A^2}{2\sigma^2}(1 + \overline{\cos\theta}^2 + \overline{\sin\theta}^2) \end{aligned} \qquad \text{(E-3)}$$

to terms of the order of r^2. Subtracting (E-1) and multiplying by W, we get for the rate of transmission of information, to terms of the order of r^2,

$$R_{p,pa} = Wr^2(1 - \overline{\cos\theta}^2 - \overline{\sin\theta}^2). \qquad \text{(E-4)}$$

From (E-4) we draw the same conclusions about the optimum distribution of θ as in Section V. As in Appendix C, we need only substitute s for r to get the corresponding results for the case of a peak-power limitation, because of the constancy of A for a PM transmitter.

When $p(\theta) = 1/2\pi$, i.e., θ is distributed uniformly from 0 to 2π, it is easy to compute the channel capacity to a higher accuracy. The average value of $_e(AV/\sigma^2)\cos(\phi-\theta)$ is then $I_0(AV/\sigma^2)$, which may be expanded in a power series. We use (C-3) to express its logarithm and effect the averaging over V by replacing the (even) powers of V by their mean values as listed in Appendix D. In this way we get

$$\begin{aligned} H(\phi, V) = {} & -\left\langle \log\left[\frac{V}{2\pi\sigma^2}e^{-(A^2+V^2)/2\sigma^2}\right]\right\rangle_{Av} \\ & - \frac{A^2}{2\sigma^2} - \frac{A^4}{8\sigma^4} + \frac{A^6}{24\sigma^6} - \frac{3A^8}{128\sigma^8} + \cdots. \end{aligned} \qquad \text{(E-5)}$$

Hence, with a uniform distribution of θ, the channel capacity is

$$C_{p,pa} = W(r^2 - \tfrac{1}{2}r^4 + \tfrac{1}{3}r^6 - \tfrac{3}{8}r^8 + \cdots). \qquad \text{(E-6)}$$

Appendix F. AM Transmission with Receiver Responsive to Both AM and PM

A receiver responsive to both amplitude and phase can eliminate the component of the received signal in quadrature with the (known) phase of the transmitted signal. (One way of doing this is to add to the received signal before amplitude demodulation a very large sine wave in phase with the transmitted signal.) The quadrature component is just noise and is uncorrelated with the in-phase component of the noise. If the amplitude of the latter is regarded as positive or negative accordingly as it is in or out of phase with the transmitter signal, it obeys a Gaussian distribution with mean value zero and standard deviation σ. The conditional distribution of the amplitude U of the in-phase component of the received signal is, then,

$$p_A(U) = \frac{1}{\sqrt{2\pi}\sigma}e^{-(U-A)^2/2\sigma^2}. \qquad \text{(F-1)}$$

The situation closely resembles the AM case at high signal-to-noise ratios. If A can be negative as well as positive, i.e., if the transmitter can be overmodulated, the optimum distribution for A subject to an average-transmitted-power limitation is Gaussian with mean value zero, and the expected information from each independent value of U is $\frac{1}{2}\log(1+a^2/\sigma^2)$, as Shannon has shown.[3] It follows that the capacity of this system is

$$C_{a,ap} = \tfrac{1}{2}W \log(1 + 2r^2) \tag{F-2}$$

for any r, small, large, or medium. When r is large, (F-2) is approximately

$$C_{a,ap} = W \log \sqrt{2}\, r. \tag{F-3}$$

If the transmitted amplitude cannot be negative, there is a loss at large signal-to-noise ratios of one bit for each independent value, bringing the capacity down to (D-1); when the signal-to-noise ratio is large, the phase of the received signal gives no information about the amplitude of the transmitted signal, and the present system becomes equivalent to the ordinary AM system. Thus, under a peak-power limitation, the capacity for large s is (D-2) when the transmitted amplitude is restricted to non-negative values. If A is not restricted as to sign, its optimum distribution is uniform from $-B$ to B, and the capacity is increased by W bits per second, i.e., by $W \log 2$ nits per second.

Signal-to-noise ratio small

We shall now determine the rate of transmission of information when r is small and an arbitrary distribution of A, specified by its moments, is used. The conditional entropy of U is readily found from (F-1) to be

$$H_A(U) = \tfrac{1}{2} + \log \sqrt{2\pi}\, \sigma. \tag{F-4}$$

Expanding part of (F-1), viz., ${}_e(AU-A^2)/2\sigma^2$, in a power series, and placing bars over the powers of A, we obtain by multiplying by the rest of (F-1) the (unconditional) distribution of U, $p(U)$.

To get the entropy of U, $H(U)$, we take $-\log p(U)$, using (C-3) for the logarithm of the series. We average it over U with A fixed by replacing U by A, U^2 by σ^2+A^2, U^3 by $3A^2+A^3$, U^4 by $3\sigma^4+6A^2\sigma^2+A^4$. The remaining averaging over A is again accomplished by putting bars over the powers of A without them.

$$H(U) = \tfrac{1}{2} + \log \sqrt{2\pi}\, \sigma + \frac{\overline{A^2} - \overline{A}^2}{2\sigma^2} - \frac{\overline{A^2}^2 - 2\overline{A^2}\,\overline{A}^2 + \overline{A}^4}{4\sigma^4} + \cdots. \tag{F-5}$$

Subtracting (F-4) and multiplying by W, we get for the rate of transmission of information

$$R_{a,ap} = W\left(\frac{\overline{A^2} - \overline{A}^2}{2\sigma^2} - \frac{\overline{A^2}^2 - 2\overline{A^2}\,\overline{A}^2 + \overline{A}^4}{4\sigma^4} + \cdots\right). \tag{F-6}$$

If the carrier amplitude $\overline{A}$ is zero, (F-6) becomes, to the present approximation, independent of any further details of $p(A)$ under an average-power limitation. Since no $p(A)$ can increase its value further, this must be the channel capacity.

$$C_{a,ap} = W(r^2 - r^4 + \cdots). \tag{F-7}$$

If the transmitted amplitude cannot be negative, $\overline{A}$ can still be made negligible by confining A to values either much less than or much greater than a, its r-m-s value. It is unnecessary for the larger value to be of the order of magnitude of the noise. The lower value is conveniently made zero. The transmitted signal then assumes the character of binary pulse code modulation with pulses occurring only a fraction as often as the bandwidth allows.

For the case of a peak-power limitation with s small, we consider the leading term of (F-6). If A is unrestricted as to sign, it should take on either of the values B and $-B$ with probability $\frac{1}{2}$, giving for the capacity Ws^2 to terms of the order of s^2. If A cannot be negative, the leading term of (F-6) is maximized by allowing A to take on the values 0 and B, each with probability $\frac{1}{2}$; the capacity is then $\frac{1}{4}Ws^2$.

APPENDIX G. RECEPTION OF AM ON PM RECEIVER

Signal-to-noise ratio large.

As (B-6) indicates, the higher the amplitude A of the transmitted signal, the smaller the difference is likely to be between the phase ϕ of the received signal and the (known) phase θ of the transmitted signal. Thus, from a knowledge of $|\phi-\theta|$, an inference can be drawn as to the order of magnitude of A.

It appears difficult to determine the distribution $p(A)$ that maximizes the rate of transmission of information from an AM transmitter to a PM receiver. However, when the signal-to-noise ratio is large, a uniform distribution of orders of magnitude of A should not be far from optimum. Such a uniform distribution of log A implies that $p(A)=k/A$ for, say, $A_1 \leqq A \leqq A_2$. For $p(A)$ to be normalized, k must be $1/\log(A_2/A_1)$.

The conditional entropy of ϕ, $H_{\theta A}(\phi)$, is the mean value of $-\log p_{\theta A}(\phi)$, with $p_{\theta A}(\phi)$ given by (B-6) Since the standard deviation of ϕ is σ/A, the mean value of the exponent is $\frac{1}{2}$. Because log A is distributed uniformly, the mean value of log A is $\frac{1}{2}(\log A_1+\log A_2) = \log \sqrt{A_1A_2}$. Thus,

$$H_{\theta A}(\phi) = \tfrac{1}{2} + \log \frac{\sqrt{2\pi}\,\sigma}{\sqrt{A_1A_2}}. \tag{G-1}$$

The unconditional distribution of ϕ, needed to determine its entropy, is

$$\begin{aligned} p(\phi) &= \int_{A_1}^{A_2} p_{\theta A}(\phi)\, k\, dA/A \\ &= \frac{k}{|\phi-\theta|} \operatorname{Erf}\left(\frac{A_2}{\sigma}|\phi-\theta|\right) \\ &\quad - \operatorname{Erf}\left(\frac{A_1}{\sigma}|\phi-\theta|\right)\Bigg]. \end{aligned} \tag{G-2}$$

If $\sigma/A_2 \ll |\phi-\theta| \ll \sigma/A_1 \ll 1$, (G-2) is approximately

$$p(\phi) = \frac{k}{2|\phi - \theta|}\cdot \tag{G-3}$$

If $p(\phi)$ is taken to be (G-3) whenever $\sigma/A_2 < |\phi-\theta| < \sigma/A_1$ and is taken to be zero otherwise, it is normalized and is, therefore, suitable for determining $H(\phi)$.

$$H(\phi) \doteq -\int_{\sigma/A_2}^{\sigma/A_1} \frac{k}{\phi} \log \frac{k}{2\phi}\, d\phi = \log \frac{2\sigma}{k\sqrt{A_1A_2}}\cdot \tag{G-4}$$

Subtracting (G-1) and multiplying by W, we have for the rate of transmission of information

$$\begin{aligned} R_{a,p} &= W \log \frac{\sqrt{2/\pi e}}{k} \\ &= W \log \left(\sqrt{\frac{2}{\pi e}} \log \frac{A_2}{A_1}\right). \end{aligned} \tag{G-5}$$

The rms transmitted amplitude is approximately $a = \sqrt{\tfrac{1}{2}k}A_2$; the peak is $B = A_2$. If $A_1 = \sigma$, $A_2/A_1 = 2r/\sqrt{k}$, and (G-5) in terms of r becomes

$$R_{a,p} = W \log \left(\sqrt{\frac{2}{\pi e}} \log \frac{2r}{\sqrt{k}}\right). \tag{G-6}$$

It is unfortunately not possible to eliminate k from (G-6), but since it is of the order of magnitude of $1/\log r$, its effect is small. In terms of s, (G-5) becomes

$$R_{a,p} = W \log \left[\sqrt{2/\pi e} \log (\sqrt{2}\, s)\right]. \tag{G-7}$$

If A is not restricted as to sign, it is possible to transmit an additional $W \log 2$ nits per second by choosing either sign with equal frequency.

Signal-to-noise ratio small

For small signal-to-noise ratio, the conditional entropy of ϕ, $H_{\theta A}(\phi)$, is given by (C-4) provided bars are placed over the powers of A. The unconditional distribution of ϕ, $p(\phi)$, is obtained from (B-8) by likewise averaging over A. Using (C-3) to express $-\log p(\phi)$, we find for its mean value

$$\begin{aligned} H(\phi) = \log 2\pi - \frac{\pi\bar{A}^2}{8\sigma^2} \\ - \frac{8\overline{A^2}^2 - 4\pi\bar{A}\,\overline{A^3} - 4\pi\bar{A}^2\,\overline{A^2} + \pi^2\bar{A}^4}{128\sigma^4} - \cdots . \end{aligned} \tag{G-8}$$

Thus, the rate of transmission of information is

$$\begin{aligned} R_{a,p} = \frac{\pi}{8}\,\frac{\overline{A^2} - \bar{A}^2}{\sigma^2} \\ - \frac{(8\pi - \pi^2 - 8)\overline{A^4} + 8\overline{A^2}^2 - 4\pi\bar{A}\,\overline{A^3} - 4\pi\bar{A}^2\,\overline{A^2} + \pi^2\bar{A}^4}{128\sigma^4} \\ + \cdots . \end{aligned} \tag{G-9}$$

The leading term of (G-9), the only significant term for small signal-to-noise ratios, is similar to the leading term of (F-6) and is maximized by the same sort of distribution of A. Under an average-power limitation, the maximum is $C_{a,p} = \tfrac{1}{4}\pi W r^2$. If A can be negative as well as positive, and $\bar{A}$ is made zero in order to maximize the first term, the second term is maximized by allowing A to take only the values a and $-a$, each with probability $\tfrac{1}{2}$. The channel capacity is then

$$C_{a,p} = \tfrac{1}{4}\pi W r^2 - \frac{8\pi - \pi^2}{32} W r^4 + \cdots . \tag{G-10}$$

With s substituted for r, this is the capacity under a peak-power limitation as well, if A is not restricted as to sign. If A cannot be negative, the capacity is, to a first approximation, quartered.

APPENDIX H. MAXIMAL TRANSMITTER AND RECEIVER UNDER A PEAK-POWER LIMITATION

We now consider a system in which the transmitter and receiver make full use of both AM and PM subject to a peak-transmitted-power limitation. The vector $A\underline{/\theta}$ representing the transmitted signal may take any position within the circle of radius B about the origin. The entropy of the received signal, which has very nearly the same distribution as the transmitted signal for large s, is thus greatest when all positions within this circle are equally likely, i.e., when the amplitude and phase of the transmitted signal have the distributions shown in Fig. 2B. The transmitted-signal power is then distributed uniformly between the values 0 and B^2. The conditional entropy of the received signal, calculated in rectangular co-ordinates, is twice (F-4), since the quadrature component of the noise introduces an entropy equal to that due to the in-phase component. In this way, the capacity for large s, $C = 2W \log (\sqrt{2/es})$, is readily obtained.

This capacity differs slightly from the corresponding expression found by Shannon,[5]

$$C \cong 2W \log (\sqrt{2/\pi e s}).$$

The difference, $W \log \pi$, must be due to Shannon's imposing the peak-amplitude limitation at twice as many sampling points as we have used. His expression for the capacity at low signal-to-noise ratios for the present case, however, is equal to ours.

The following principle makes possible a simple derivation of the capacity and optimum statistics when s is small. On substituting for s in the expression for the capacity of a peak-power-limited system, its value in terms of r for the optimum transmitted-amplitude distribution (see Fig. 2), one obtains a quantity which cannot exceed the expression for the capacity of such a system under an average-power limitation, since the latter is the maximum rate of transmission of information for a given r.

Now noting that system IV is a special case of system I in which the transmitted amplitude is constant, and substituting r for s ($r=s$ for Fig. 2A) in the expression for the capacity of system IV for small s, we obtain an expression identical with the capacity for system I under an average-power limitation for small r. It follows that the capacity and optimum statistics are the same for system I as for system IV under a peak-power limitation when s is small.

---

[5] Reference 3, p. 643.

The same considerations applied to system V with small s lead to the same capacity for system I, but different optimum statistics are obtained. It can be shown by an analysis of system I in the same way we have analyzed the other systems at small signal-to-noise ratios that, to a first approximation, the rate of transmission of information is

$$R_1 = (\overline{A^2} - | A\underline{/\theta} |^2)W/2\sigma^2. \qquad \text{(H-1)}$$

This rate is greatest when the amplitude of the transmitted signal is constant and equal to B, and the distribution of its phase has no Fourier first-harmonic component. Such is the case for the phase distribution of Fig. 2A; it is also the case for the amplitude distribution of Fig. 2E if the latter is regarded as having a constant amplitude but phase 0 or π, each with probability $\frac{1}{2}$. In this approximation, the rate of transmission of information is not affected by the difference between these distributions.

Distributed Amplifier Theory*

DELMAR V. PAYNE†, SENIOR MEMBER, IRE

Summary—**The mathematical theory of the operation of the plate line of a distributed amplifier is developed using matrix algebra as a tool. The effects of a finite number of current generators placed at regular intervals on what would otherwise be an ordinary lumped-constant transmission line are determined. The theory predicts the manner in which the output of a distributed amplifier is changed with propagation constant of the grid and plate lines, termination of the grid and plate lines, number of tubes, and grid driving voltage. Some of the deductions made were tested using a six tube distributed amplifier; and, the experimental results were found to be in general agreement with predicted results.**

INTRODUCTION

THE DISTRIBUTED AMPLIFIER, invented by W. S. Percival, was an attempt to increase the gain-bandwidth product of an amplifier by separating the individual tube interelectrode capacitances while adding their transconductances.[1,2] Considerable work has been done in the United States on the applications and improvement of operation of this type of amplifier.[3–5] The objective of increased gain-bandwidth product was attained by separating individual tubes by a portion of a lumped-constant transmission line as indicated in Fig. 1. An examination of Fig. 1 shows that, for Class A operation, the current and voltage equations for the grid line may be found by the usual methods of analysis of lumped-constant transmission lines; but, the plate line, since it contains the tubes as active elements, may not be analyzed by these methods. This paper is concerned with the analysis of the plate line.

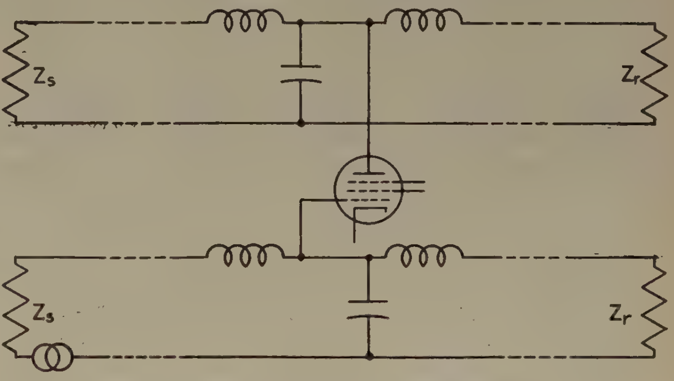


Fig. 1—Schematic of a distributed amplifier.

ANALYSIS OF THE PLATE LINE

In order to simplify the mathematics and to approximate existing conditions over the useful frequency range, a number of assumptions were made.

1. All elements other than tubes are assumed to be linear and passive.
2. There is no magnetic coupling between inductive elements.
3. The lines, both plate and grid, are assumed to be composed of identical sections.
4. The tubes are capable of being represented by current generators.
5. The currents and voltages may be expressed by sine and cosine functions of time.

---

* Decimal classification: R363.4×R132. Original manuscript received by the Institute, August 26, 1951; revised manuscript received, November 10, 1952. Extract from a report submitted in partial fulfillment of requirements for the M.S. degree at the Graduate School of Kansas State College.

† Bendix Aviation Corporation, Research Laboratories, Detroit, Mich.

[1] William S. Percival, British Patent 460,562.

[2] H. A. Wheeler, "Wide-band Amplifiers for Television," PROC. I.R.E., vol. 27, pp. 429–438; July, 1939.

[3] E. L. Gintzon, W. R. Hewlett, J. W. Jasberg, and J. D. Noe, "Distributed Amplification," PROC. I.R.E., vol. 36, pp. 956–969; August, 1948.

[4] W. W. Horton, J. W. Jasberg and J. D. Noe, "Distributed Amplifiers: Practical Considerations and Experimental Results," PROC. I.R.E., vol. 38, pp. 748–753; July, 1950.

[5] H. G. Rudenberg and F. Kennedy, "300-mc Traveling-wave Chain Amplifier," *Electronics*, vol. 22, pp. 106–109; December, 1949.

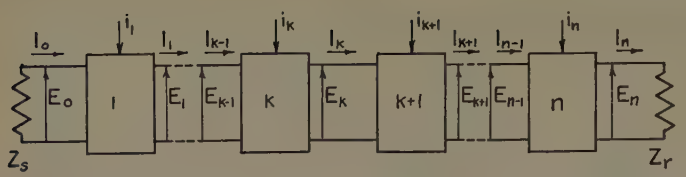


Fig. 2—Block diagram of the plate line of a distributed amplifier showing assumed directions of currents and voltages.

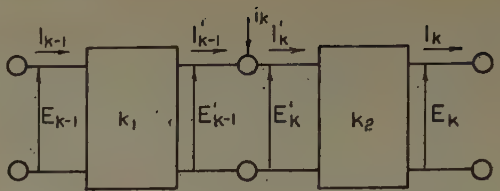


Fig. 3—Block diagram of the *k*th section of the plate line of a distributed amplifier which is composed of *n* identical sections.

Consider the periodic structure shown schematically in Fig. 2. The construction of each identical three-terminal pair is shown in more detail in Fig. 3. The equations of the *kth* three-terminal pair are of the form

$$\begin{bmatrix} E_{k-1} \\ I_{k-1} \\ 1 \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} & 0 \\ a_{21} & a_{22} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} E_{k-1}' \\ I_{k-1}' \\ 1 \end{bmatrix},$$

$$\begin{bmatrix} E_{k-1}' \\ I_{k-1}' \\ 1 \end{bmatrix} = \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & -i_k \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} E_k' \\ I_k' \\ 1 \end{bmatrix},$$

$$\begin{bmatrix} E_k' \\ I_k' \\ 1 \end{bmatrix} = \begin{bmatrix} b_{11} & b_{12} & 0 \\ b_{21} & b_{22} & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} E_k \\ I_k \\ 1 \end{bmatrix}.$$

If the proper substitutions are made in these equations and the indicated multiplications are performed, a 3×3 matrix of the form

$$\begin{bmatrix} E_{k-1} \\ I_{k-1} \\ 1 \end{bmatrix} = \begin{bmatrix} c_{11} & c_{12} & c_{13}i_k \\ c_{21} & c_{22} & c_{23}i_k \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} E_k \\ I_k \\ 1 \end{bmatrix} \tag{1}$$

is obtained. Equation (1) is not particularly useful since the 3×3 matrix has elements containing i_k. Equation (1) may be rearranged, after introducing $ik-1$, to obtain

$$\begin{bmatrix} E_{k-1} \\ I_{k-1} \\ \cdots \\ i_{k-1} \end{bmatrix} = \left[\begin{array}{cc:c} c_{11} & c_{12} & c_{13} \\ c_{21} & c_{22} & c_{23} \\ \cdots & \cdots & \cdots \\ 0 & 0 & \zeta \end{array}\right] \begin{bmatrix} E_k \\ I_k \\ \cdots \\ i_k \end{bmatrix} \tag{2}$$

where ζ will be of the form e^{Γ}. Γ is complex and is recognized to be the propagation constant of the grid line.

In order to investigate the plate line without obscuring the results by the details, divide the 3×3 matrix of (2) into submatrices as indicated. Call

$$D = \begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix}, \qquad F = \begin{bmatrix} c_{13} \\ c_{23} \end{bmatrix},$$

$$X_k = \begin{bmatrix} E_k \\ I_k \end{bmatrix}, \qquad X_{k-1} = \begin{bmatrix} E_{k-1} \\ I_{k-1} \end{bmatrix}.$$

Equation (2) may now be written

$$\begin{bmatrix} X_{k-1} \\ i_{k-1} \end{bmatrix} = \begin{bmatrix} D & F \\ 0 & \zeta \end{bmatrix} \begin{bmatrix} X_k \\ i_k \end{bmatrix}, \tag{3}$$

where $0 = [0\ 0]$. The matrix equation for any three-terminal pair of the plate line is identical to (3) except for subscripts, so that the process of relating the *kth* voltage and currents to the *k-nth* voltage and current centers around the *nth* power of the matrix

$$\begin{bmatrix} D & F \\ 0 & \zeta \end{bmatrix}. \tag{4}$$

It may be proven by induction that the form of the *nth* power of the matrix is

$$\begin{bmatrix} D & F \\ 0 & \zeta \end{bmatrix}^n = \begin{bmatrix} D^n & D^{n-1}F + D^{n-2}F\zeta + \cdots + DF\zeta^{n-2} + F\zeta^{n-1} \\ 0 & \zeta^n \end{bmatrix}. \tag{5}$$

D is the 2×2 transformation matrix relating input and output voltages and current when there is no current i_k, as in the grid line. It is observed that D^n relates

$$X_0 \text{ to } X_n,$$

$$D^{n-1}F + D^{n-2}F\zeta + \cdots + DF\zeta^{n-2} + F\zeta^{n-1}$$

relates X_0 to i_n and ζ^n relates i_0 to i_n (i_0 is a fictitious quantity).

Propagation constant is related to elements of D by[6]

$$e^{\gamma}, e^{-\gamma} = 1/2(c_{11} + c_{22}) \pm 1/2[(c_{11} + c_{22})^2 - 4]^{1/2}. \tag{6}$$

γ is associated with the right traveling components of voltage and current; and, $-\gamma$ is associated with the left traveling components of voltage and current. Let

$$E_n = A_1 + A_2, \quad I_n = B_1 + B_2, \quad i_n = C_1 + C_2. \tag{7}$$

where the subscript 1 designates the right traveling components and the subscript 2 designates the left traveling components.[7] Represent the iterative impedances of the plate line at some point k by Z_{01} and Z_{02}; also, represent the iterative impedances of the line at the point of entry of some current i_k by Z_{01}' and Z_{02}'. Let

$$B_1 = \frac{A_1}{Z_{01}}, \qquad B_2 = \frac{A_2}{-Z_{02}},$$

$$C_1 = \frac{i_n Z_{02}'}{Z_{01}' + Z_{02}'}, \qquad C_2 = \frac{i_n Z_{01}'}{Z_{01}' + Z_{02}'}. \tag{8}$$

---

[6] Leon Brillouin, *Wave Propagation in Periodic Structures*, McGraw-Hill Book Company, Inc., New York, N. Y., 1946, p. 211.

[7] Ernst A. Guillemin, *Communication Networks, Vol. II*. John Wiley and Sons, Inc., New York, N. Y., 1935, p. 165.

$F\ i_n$ gives a voltage $E'=c_{13}\ i_n$ and a current $I'=c_{23}i_n$. The impedance relation between E' and I' is

$$\frac{E'}{I'}=\frac{c_{13}}{c_{23}}.$$

Split E' and I' into right and left traveling components

$$\begin{aligned} I' &= c_{23}C_1+c_{23}C_2=\frac{i_nc_{23}Z_{02}'}{Z_{01}'+Z_{02}'}+\frac{i_nc_{23}Z_{01}'}{Z_{01}'+Z_{02}'} \\ E' &= c_{23}C_1\left(\frac{c_{13}}{c_{23}}\right)+c_{23}C_2\left(-\frac{c_{13}}{c_{23}}\right) \\ &= \frac{i_nc_{13}Z_{02}'}{Z_{01}'+Z_{02}'}-\frac{i_nc_{13}Z_{01}'}{Z_{01}'+Z_{02}'}. \end{aligned} \tag{9}$$

Substitute (7) and (8) into the equation

$$\begin{bmatrix} X_0 \\ i_0 \end{bmatrix}=\begin{bmatrix} D & F \\ 0 & \zeta \end{bmatrix}^n\begin{bmatrix} X_n \\ i_n \end{bmatrix}$$

to get

$$\begin{aligned} E_0 &= A_1e^{n\gamma}+A_2e^{-n\gamma}+\frac{c_{13}i_nZ_{02}'}{Z_{01}'+Z_{02}'}\xi_1 \\ &\quad -\frac{c_{13}i_nZ_{01}'}{Z_{01}'+Z_{02}'}\xi_2 \\ I_0 &= B_1e^{n\gamma}+B_2e^{-n\gamma}+\frac{c_{23}i_nZ_{02}'}{Z_{01}'+Z_{02}'}\xi_1 \\ &\quad +\frac{c_{23}i_nZ_{01}'}{Z_{01}'+Z_{02}'}\xi_2. \end{aligned} \tag{10}$$

where

$$\xi_1=e^{(n-1)\gamma}+\zeta e^{(n-2)\gamma}+\cdots+\zeta^{n-1}$$

$$\xi_2=e^{-(n-1)\gamma}+\zeta e^{-(n-2)\gamma}+\cdots+\zeta^{n-1}.$$

In order to solve for A_1 and A_2, make use of (8) and the boundary conditions $E_0+I_0Z_s=0$, $E_n-I_nZ_r=0$.

$$\begin{aligned} A_1 &= \frac{-i_n(Z_sc_{23}+c_{13})}{(Z_s+Z_{01})(Z_{01}'+Z_{02}')}\;\frac{\left[Z_{02}'\xi_1+\dfrac{(Z_sc_{23}-c_{13})}{(Z_sc_{23}+c_{13})}Z_{01}'\xi_2\right]Z_{01}}{(e^{n\gamma}-R_sR_re^{-n\gamma})} \\ A_2 &= \frac{-i_n(Z_sc_{23}+c_{13})}{(Z_s+Z_{01})(Z_{01}'+Z_{02}')}\;\frac{\left[Z_{02}'\xi_1+\dfrac{(Z_sc_{23}-c_{13})}{(Z_sc_{23}+c_{13})}Z_{01}'\xi_2\right]R_RZ_{02}}{(e^{n\gamma}-R_sR_re^{-n\gamma})} \end{aligned} \tag{11}$$

where

$$R_s=\frac{Z_s-Z_{02}}{Z_s+Z_{02}}\quad\text{and}\quad R_r=\frac{Z_r-Z_{01}}{Z_r+Z_{01}}.$$

The output voltage, E_n, of the plate line may be found in terms of the signal impressed on the grid line, e_0, by substituting (11) into the first of (7) and letting $i_n=g_me_n=g_me_0\zeta^{-n}$

$$E_n=\frac{-g_me_0\zeta^{-n}(Z_sc_{23}+c_{13})}{(Z_s+Z_{01})(Z_{01}'+Z_{02}')}\;\frac{\left[Z_{02}'\xi_1+\dfrac{(Z_sc_{23}-c_{13})}{(Z_sc_{23}+c_{13})}Z_{01}'\xi_2\right](Z_{01}+R_rZ_{02})}{(e^{n\gamma}-R_sR_re^{-n\gamma})} \tag{12}$$

where g_m is the transconductance of the tubes and is assumed to be constant. The conditions usually attempted in the construction of a distributed amplifier are $Z_{01}=Z_{02}=Z_0$, $Z_{01}'=Z_{02}'=Z_0'$, $\zeta=e^{\gamma}$, and $R_s=0$.

CONCLUSIONS

Several things may be concluded from an inspection of (12).

(a) A plot of gain versus frequency will fluctuate about some average in a nearly periodic manner.

(b) Making

$$\left|\frac{Z_sc_{23}-c_{13}}{Z_sc_{23}+c_{13}}\right|<1$$

or making the real part of the propagation constant of the plate line greater than zero will reduce the magnitude of the variations of gain with frequency change.

(c) Increasing the number of tubes should make the ratio of maximum to minimum gain in the usable frequency spectrum approach one provided that the real part of the plate line propagation constant is not zero.

(d) The gain of the amplifier should be doubled by making the reflection factor, R_r, at the receiving end of the plate line be equal to one.

(e) In order that the average gain of the amplifier be constant and high, the real part of the propagation constant of the grid line should be as nearly zero as possible.

An amplifier was constructed using six tubes and constant-*k* sections for the grid and plate lines to test the conclusions listed as (a) and (d). *m*-derived half-sections were used to terminate the lines in their characteristic impedance. A typical section of the amplifier is shown in Fig. 4. Computation reveals that the elements of the 3×3 matrix of (1) are in this case

$$\begin{array}{lll} c_{11}=1+\tfrac{1}{2}YZ & c_{12}=\tfrac{1}{4}YZ^2+Z & c_{13}=-\tfrac{1}{2}Z \\ c_{21}=1 & c_{22}=1+\tfrac{1}{2}YZ & c_{23}=-1 \\ c_{31}=0 & c_{32}=0 & c_{33}=1. \end{array}$$

It was assumed that $Z_{01}'=Z_{02}'=Z_0'$, $R_s=0$, $\zeta=e^{\gamma}$, and $\gamma=j\beta$. The absolute value of the gain was computed from the equation

$$|G| = \left|\frac{g_m(Z_0+\frac{1}{2}Z)}{2}\right| \left| 3 + \frac{(Z_0+\frac{1}{2}Z)}{(Z_0+\frac{1}{2}Z)}(\cos\beta+\cos 3\beta+\cos 5\beta)e^{-5j\beta}\right| \left|1+R_r\right|. \qquad (13)$$

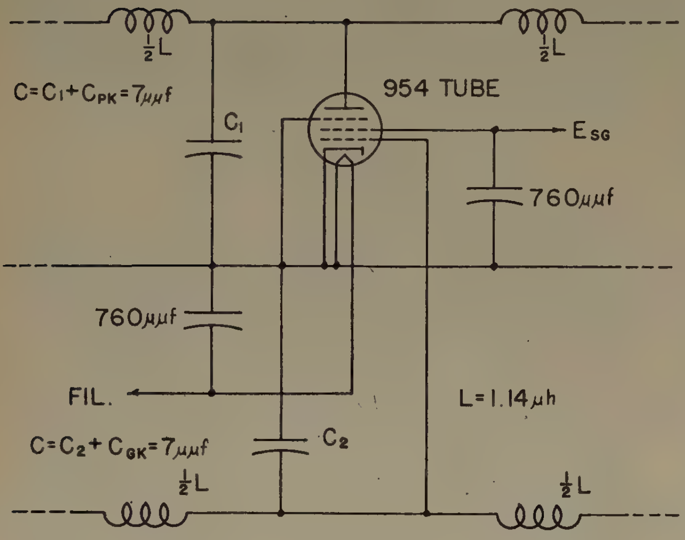


Fig. 4—Typical section of a six section experimental amplifier.

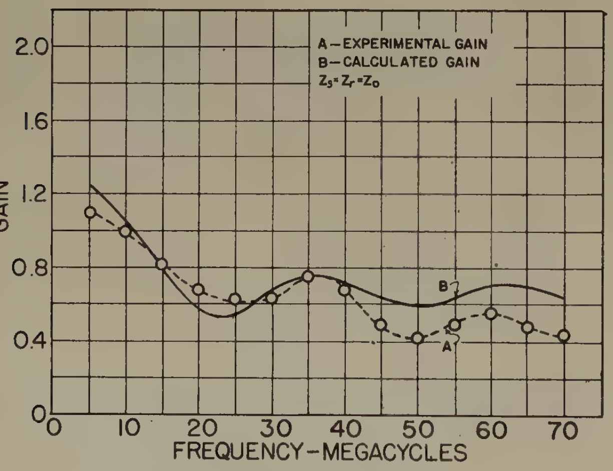


Fig. 5—Predicted and experimental gain characteristics of a six tube distributed amplifier with the plate and grid lines terminated in their characteristic impedances.

The first experiment was designed to show the presence of the cosine terms and the $e^{-5j\beta}$ multiplier. Here $R_r=0$. The results are shown in Fig. 5. It is seen that the theory has been borne out reasonably well.

The second experiment attempted to show the presence of the $1+R_r$ term in the numerator of (13). R_r was made as large as possible consistent with the measuring technique used. The results are shown graphically in Fig. 6. The difference between the calculated and experimental gain curves may be explained on the basis of $R_s \neq 0$ at all frequencies.

ACKNOWLEDGMENT

The author would like to thank Professor J. E. Wolfe for checking the electrical concepts of the theory and for his advice on the construction of the experimental amplifier. Dr. P. M. Young is to be thanked for his review of the matrix algebra used; and Professors Joe. E. Ward and W. R. Ford are to be thanked for their help and advice on the construction and testing of the experimental amplifier.

Dr. A. C. Hall and Mr. M. T. Gannon of Bendix Aviation Corporation have been helpful in their criticisms of the paper and getting it into a form suitable for publication.

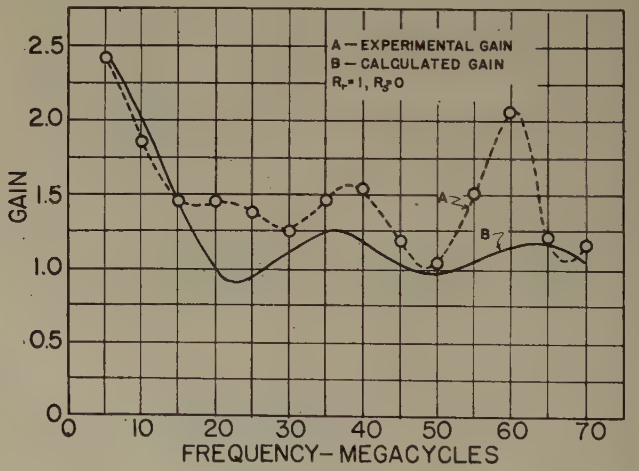


Fig. 6—Predicted and experimental gain characteristics of a six tube distributed amplifier with the output end of the plate line open-circuited and the other end as well as both ends of the grid line terminated in the characteristic impedance of the lines.

* * *

Calculation of a Waveguide-Loaded Resonator for Interdigital Magnetrons*

GUNNAR HOK†, SENIOR MEMBER, IRE

Summary—**The electromagnetic-field configuration in the various parts of the resonator is considered, as well as the boundary relations at the junctions between them. The result is used to relate resonance frequency and Q to the geometry and to design the output transducer so that the desired slot conductance is obtained for the electronic operation of the magnetron.**

1. INTRODUCTION

SINCE THE WORK of Crawford and Hare[1] during World War II the interdigital magnetron has been subject to a fair amount of interest. Research groups at Harvard,[2] at the Signal Corps' Laboratories,[3] and at the University of Michigan[4] have in particular contributed to the literature on this topic. The present paper reports the result of an investigation undertaken in 1949, the purpose of which was to study the impedance transformation from a waveguide load, constituting the output terminals, to the anode segments forming the input terminals of the resonator of an interdigital magnetron operating circumferentially in its second-order mode. The objective was to work out a design procedure whereby the conductance at the anode segments could be made to agree at a specified resonance frequency with an optimum value prescribed by the dimensions of the electronic system. The solution of this design problem is not unique; it is, therefore, possible to take into account also conditions for frequency stability and circuit efficiency. For this reason, calculations of external and internal Q, as well as a discussion of the choice of the major design parameters, were included in the investigation reported here.

Fig. 1 shows a somewhat simplified model of an interdigital magnetron resonator, in two slightly different versions, A and B. The central cylindrical post K represents the cathode, F the finger system, i.e., the interdigital anode segments (developed in Fig. 2), I interaction space, C the cavity external to the fingers, T the waveguide transformer section, and G the waveguide. In model A, the interaction space and the cavity are of equal axial height, so that the resonator appears as a flat cylindrical cavity with a central post and a number of fingers arranged in a circle and fixed each to one of the flat walls. In model B, the interaction space has been extended at E in axial direction as a first approximation of the actual insulating space between anode and cathode which, because of cathode end hats, pole pieces, and the like, has too complicated a geometry for close calculation. The analysis presented here starts out from the geometry of model A; the modifications introduced by the extended interaction space are discussed later and compared with experimental data.

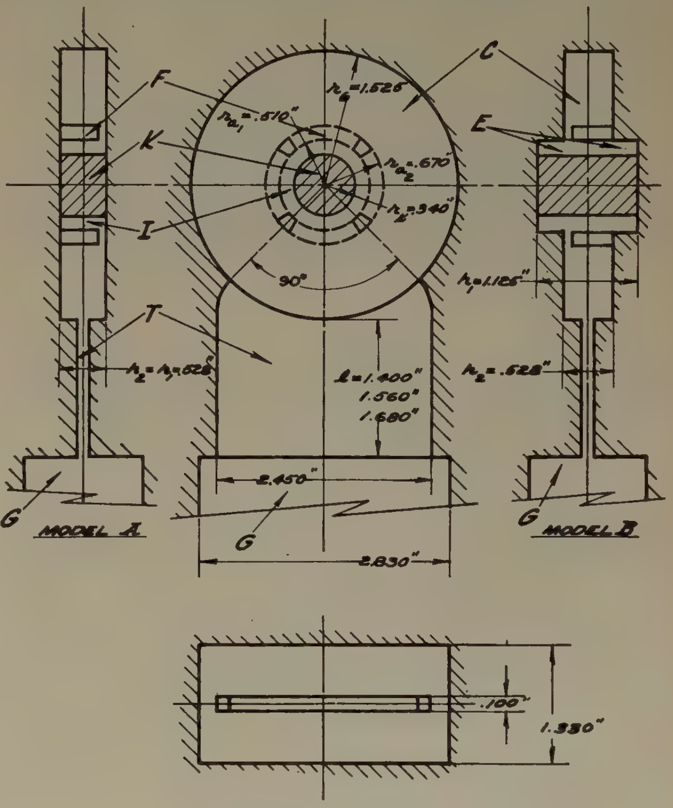


Fig. 1—Model cavity and output transformer.
Cold test model.

The design problem includes choice of suitable matching network between cavity and waveguide, and calculation of optimum dimensions of this network.

The main alternatives offered are a simple aperture, a quarter-wave uniform waveguide section, or a tapered waveguide section. The order given represents decreasing simplicity and increasing bandwidth. As a compromise solution, the second alternative has been chosen. It is undesirable to have a transducer which is too frequency-sensitive, particularly if it may be anticipated that tunable or semitunable resonators will ultimately be desired. However, the desired bandwidth was in this case not so large as to require a tapered transformer.

---

* Decimal classification: R119×R118. Original manuscript received by the Institute, January 16, 1952; revised manuscript received November 10, 1952.

† Dept. of Electrical Engineering, University of Michigan, Ann Arbor, Mich.

[1] F. H. Crawford and M. D. Hare, "Tunable squirrel-cage magnetron—the donutron," PROC. I.R.E., vol. 35, pp. 361–369; April, 1947.

[2] W. S. Lucke, "Obstacle-Loaded Cylindrical Cavities with Application to the Interdigital Magnetron," Technical Report No. 80, Cruft Laboratory, Harvard University, Cambridge, Mass., under Contract NR-OR1-76, Task Order No. 1, NR-078-011.

[3] J. F. Hull and L. W. Greenwalt, "Modes in interdigital magnetrons," PROC. I.R.E., vol. 37, pp. 1258–1263; November, 1949.

[4] H. W. Welch, Jr. and G. R. Brewer, "Operation of Interdigital Magnetrons in the Zero-Order Mode," Technical Report No. 2, Electron Tube Laboratory, University of Michigan, Ann Arbor, Mich.

Several ways of designing the transformer section are open. Fig. 3 shows: (a) a section employing cylindrical waves and forming a natural extension of the cavity, (b) a rectangular section, and (c) a "ridged" or "H-shaped" section.

The first and the third of these alternatives are suitable when the cavity is small compared to the wavelength. In the present design problem, the second alternative can be applied without approaching the cut-off frequency of the transformer section too closely. The design chosen is shown in Fig. 1.

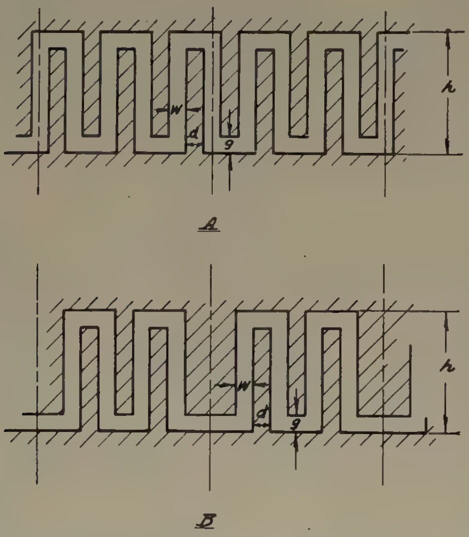


Fig. 2—Development of the anode structure. (A) Uniform finger arrangement. (B) Phase reversing finger arrangement.

2. Geometrical Discontinuities[5,6,7,8,9]

Even the simplified resonator model shown in Fig. 1 has a complex structure, and the successful calculation of the electromagnetic field in the cavity requires a satisfactory method for matching the fields at the boundary surfaces between sections of the cavity of different elementary forms, such as annular cylinder, parallelepiped, and so on. We shall therefore briefly discuss such methods and quote the relations to be used for the impedance-transformation problem under study. The basic approach is that of harmonic analysis. The solutions of the vector wave equation in each elementary form of waveguide or cavity constitute a complete set of orthogonal functions or normal modes. Any field configuration that satisfies Maxwell's equations and the boundary conditions can be represented "almost everywhere" by a sum of normal-mode components. When two systems of different elementary geometry are joined together, it is consequently possible to express the field in the combined cavity in terms of the normal modes of either one of them, and the field at any point can be "translated" from one set of normal modes to the other. This approach leads to a simple equivalent network of the junction and gives a convenient physical picture of the transmission past the junction. For quantitative work, however, it has the disadvantage of frequently giving infinite sums of rather slow convergence. For this reason other methods based on approximate static equivalence, as Schwinger's variational procedure, are often used for this purpose. In work reported here available handbook data were used as far as possible, in addition to basic formulas derived from the orthogonal expansions.

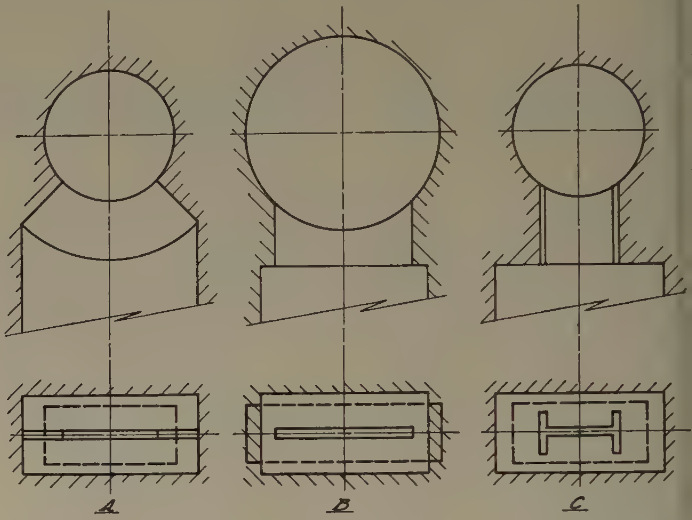


Fig. 3—Waveguide to cavity transformers. (A) Cylinder sector. (B) Rectangular waveguide. (C) H-shaped waveguide.

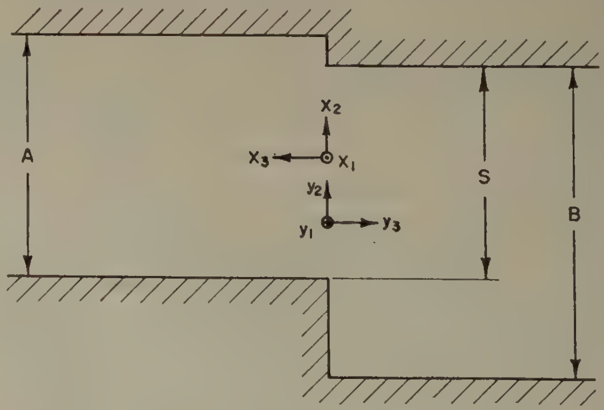


Fig. 4—Schematic representation of the junctions of two different waveguides.

The translation of the field from a sum of normal modes in one section to the corresponding sum in an adjoining section is reasonably simple if a boundary between the two sections can be so chosen that it is an equiphase surface in both mode systems or, in other words, that it satisfies equations $x_\nu=$constant and $y_\mu=$constant in the natural co-ordinate systems of the two sections (Fig. 4). A particularly simple result is ob-

---

[5] Gunnar Hok, "Calculation of a Wave-Guide-Loaded Resonator for Interdigital Magnetrons," Technical Report No. 14, Electron Tube Laboratory, University of Michigan; September, 1952.

[6] J. Schwinger, "Discontinuities in Wave Guides," Notes from lectures at Radiation Laboratory, M.I.T., Cambridge, Mass.; 1945.

[7] J. R. Whinnery and H. W. Jameson, "Equivalent circuits for discontinuities in transmission lines," Proc. I.R.E., vol. 32, p. 98; February, 1944.

[8] J. W. Miles, "The equivalent circuit for a plane discontinuity in a cylindrical waveguide," Proc. I.R.E., vol. 34, pp. 728–742; October, 1946.

[9] N. Marcuvitz, "The Wave Guide Handbook," Radiation Laboratory Series, McGraw-Hill Book Co., Inc., New York, N. Y., vol. 10; 1951

tained if this boundary surface S forms the cross section of the smaller one of the two waveguide sections ($S=A$ in the notation of Fig. 4). Equating the sum of transverse field components at this surface then leads to the following equation of compatibility between the wave admittances of all the modes present:

$$\begin{vmatrix} \overline{Y}_{A1}+\sum\limits_{\mu=1}^{\infty}\alpha_{1\mu}{}^2\cdot\overline{Y}_{B\mu} & \sum\limits_{\mu=1}^{\infty}\alpha_{1\mu}\alpha_{2\mu}\cdot\overline{Y}_{B\mu}\cdots \\ \sum\limits_{\mu=1}^{\infty}\alpha_{1\mu}\cdot\alpha_{2\mu}\cdot\overline{Y}_{B\mu} & \overline{Y}_{A2}+\sum\limits_{\mu=1}^{\infty}\alpha_{2\mu}{}^2\cdot\overline{Y}_{B\mu}\cdots \\ \cdots & \cdots \end{vmatrix} = 0, \qquad (1)$$

where the $\overline{Y}$'s are the wave admittances identified by the subscripts and the α's are defined in terms of the orthonormal wave functions of the modes e_A and e_B, according to the relation

$$\alpha_{\nu\mu} = \int_S e_{A\nu}e_{B\mu}dS. \qquad (2)$$

By definition, of course,

$$\int_A e_{A\nu}{}^2dA = \int_B e_{B\mu}{}^2dB = 1. \qquad (3)$$

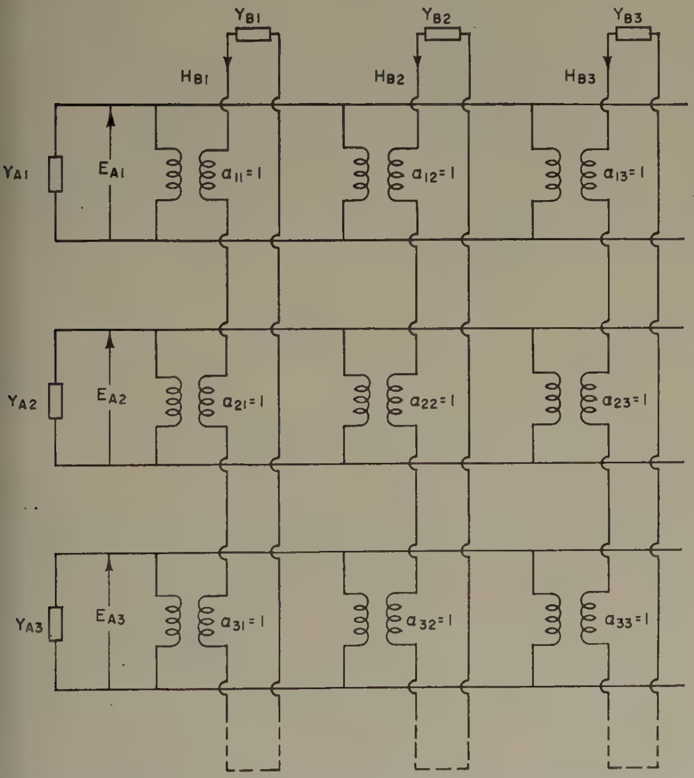


Fig. 5—Equivalent network of the junction of two waveguides. (Boundary surface is equal to cross section of smaller guide.)

Equation (1) must be satisfied for any set of steady-state field components that are not all equal to zero. Under such conditions at least one admittance must be active. If the junction is "illuminated" in the $A1$ mode, for instance, $\overline{Y}_{A1}$ is active, and the input admittance of the junction is obtained by solving (1) for $-\overline{Y}_{A1}$.

It should be noted that in an approximate solution of (1) it is always necessary to include a larger number of modes in system B than in system A. When the magnetic field is expanded by means of the α's only, it is physically obvious that the magnetic field in guide B determines the magnetic field in guide A, but not vice versa since the field over the area $B-A$ is unknown. The original system of equations from which (1) is derived would be incompatible with this condition, if an equal number of modes were included in both systems.

An optional form of (1) is obtained if the wave admittances are replaced by the corresponding wave impedances of the other waveguide. However, the order of the determinant is then determined by the number of modes in guide B to be taken into account, and the solution is less convenient. When the junction is illuminated from the latter side, it may still be preferable to use this alternate form of (1) since, otherwise, the active wave admittance appears in every element of the determinant and is the root of an equation of the same degree as the order of the determinant.

The solution for the case $S=A$ can of course be extended to the general case $A\neq S\neq B$ by considering S as the cross section of an infinitely short waveguide. The first approximation including only the corner element of the compatibility determinant is

$$-\overline{Y}_{A1} \approx \frac{1}{\alpha_{11}{}^2}\left\{\beta_{11}{}^2\overline{Y}_{B1} + \sum_{\mu=2}^{\infty}(\alpha_{\mu1}{}^2\overline{Y}_{A\mu} + \beta_{\mu1}{}^2\overline{Y}_{B\mu})\right\}, \qquad (4)$$

where the definitions of α and β are analogous to (2). A set of orthonormal wave functions over S serves as an intermediate step between e_A and e_B.

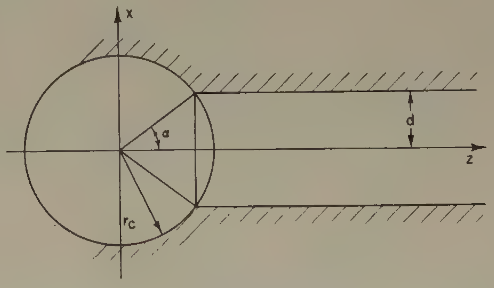


Fig. 6—Junction of a cylindrical cavity with a rectangular waveguide.

A common example of a junction where the boundary surface between the two systems is not the same is described by the two relations $x_3=$constant and $y_3=$constant is shown in Fig. 6. A rectangular waveguide opens directly into a cavity formed by a rotational cylinder or a sector of such a cylinder. The problem of wave propagation from the cavity to the waveguide, or vice versa, can be solved by three orthogonal transformations, one three-dimensional from plane waves (subscript G) to cylindrical waves[10] (subscript A) in the waveguide, and two two-dimensional transformations over the cylindrical boundary ($r=r_c$ in Fig. 6), from the waves outside the boundary (subscript B, directly obtained from waves A by setting $r=r_c$) to wave functions orthogonal over the waveguide opening (subscript S), and finally from these wave functions to the cavity modes (subscript C). For the latter two transformations we define coefficients $\gamma_{\mu\nu}$ and $\eta_{\mu\nu}$ exactly analogous to $\alpha_{\mu\nu}$ and $\beta_{\mu\nu}$ above.

---

[10] J. A. Stratton, "Electromagnetic Theory," McGraw-Hill Book Co., Inc., New York, N. Y., p. 371; 1941.

The general element in the compatibility determinant

$$D[L_{mn}] = 0 \tag{5}$$

is in this case

$$L_{mn} = \sum_{\mu} a_{\mu m} \sum_{\nu} \gamma_{\mu\nu} \cdot \overline{Y}_{S\nu n} + Y_0 \sum_{\mu} \gamma_{\mu n} b_{\mu m}, \tag{6}$$

where

$$\overline{Y}_{S\nu n} = \sum_{\mu} \eta_{\mu\nu} \cdot \eta_{\mu n} \overline{Y}_{C\mu}; \tag{7}$$

for TE-modes in the wave guide and TM-modes in the cavity,

$$a_{0\mu} = \frac{q}{\sqrt{2}} J_0(kr_c)[(1 + \rho_\mu)] \tag{8}$$

$$a_{\nu\mu} = q \cdot J_\nu(kr_c)[(-j)^\nu + \rho_\mu \cdot j^\nu] \cos \nu\beta_\mu \quad (\nu > 0) \tag{9}$$

$$b_{0\mu} = \frac{jq}{\sqrt{2}} J_0'(kr_c)[1 + \rho_\mu] \tag{10}$$

$$b_{\nu\mu} = jqJ_\nu'(kr_c)[(-j)^\nu + \rho_\mu j^\nu] \cos \nu\beta_\mu \quad (\nu > 0) \tag{11}$$

$$k = 2\pi/\lambda \tag{12}$$

$$\cos \beta_\mu = \left[1 - \left(\frac{\mu\lambda}{4d}\right)^2\right]^{1/2}. \tag{13}$$

The factor q is a normalizing factor that disappears in the final solution. The complex reflection coefficients ρ_μ in the waveguide are introduced instead of the wave admittances $\overline{Y}_{G\mu}$ because the three-dimensional wave functions of waves traveling in opposite directions are orthogonal and have to be introduced separately; ρ_μ is specified at $r=z=0$, the axis of the cavity, and Y_0 is the wave admittance of free space $(\epsilon_0/\mu_0)^{1/2}$.

A first approximation of the input admittance of the junction as seen by the lowest-order mode in the cavity is obtained by considering only one mode in the waveguide and the lowest-order wave function over the waveguide opening. The result is calculated from (7) and

$$-Y_{S11} = Y_0 \frac{\sum_{\nu} b_{\nu 1}\gamma_{\nu 1}}{\sum_{\nu} a_{\nu 1}\gamma_{\nu 1}}. \tag{14}$$

When only one mode propagates in a waveguide or resonates in a cavity, the junction can be represented by an equivalent network consisting of an ideal transformer and a shunt susceptance. The turn ratio of the ideal transformer is usually obtained with sufficient accuracy from a first approximation using only one element of the compatibility determinant. The shunt susceptance can be determined from a higher-order approximation, or often estimated from electrostatic considerations, or handbook data for similar geometries.

3. IMPEDANCE VARIATION IN WAVEGUIDE SECTIONS

The whole structure of resonator and output transformer forms a transmission line made up of short sections of different kinds of waveguide pieced together.

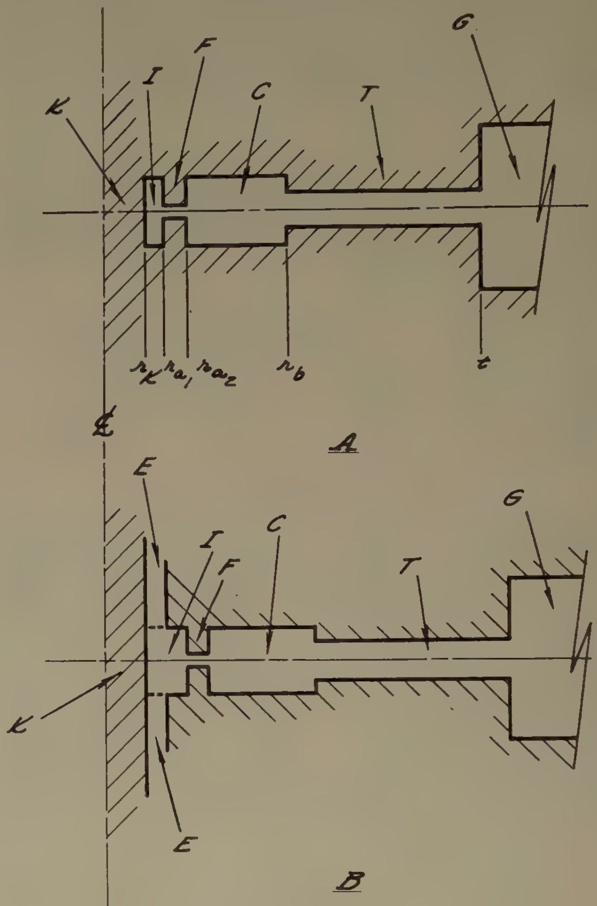


Fig. 7—Equivalent-waveguide representation of resonator and output system.

Schematically, the resonators shown in Fig. 1 are represented as such transmission lines or waveguides in Fig. 7. The section F representing the finger system that forms the anode of the magnetron is so short in the direction of propagation that it can be represented by a lumped susceptance. In the interaction space (I) and the cavity external to the fingers (C) the electromagnetic field can be expressed as a sum of cylindrical waves traveling in radial direction and in the transformer section (T) and waveguide (G) as a sum of plane waves.

The analytical expressions for the field components of a wave that travels towards the axis of the cylinder involve the Hankel function of the first kind and its first derivative, those of a wave that travels away from the axis involve the Hankel function of the second kind and its derivative.[11] We introduce the following notation for an arbitrary cylinder function of order n (i.e., waves with $2n$ zeros circumferentially):

---

[11] S. Ramo and J. R. Whinnery, "Fields and Waves in Modern Radio," John Wiley and Sons, New York, N. Y., p. 354; 1944.

$$\begin{aligned} Z_n(k_r r) &= AH_n{}^{(1)}(k_r r) + BH_n{}^{(2)}(k_r r) \\ &= G_n(Ae^{i\theta} + Be^{-i\theta}) \end{aligned} \tag{15}$$

$$\begin{aligned} Z_n'(k_r r) &= A\frac{\partial}{\partial k_r r}H_n{}^{(1)}(k_r r) + B\frac{\partial}{\partial k_r r}H_n{}^{(2)}(k_r r) \\ &= j\overline{G}_n(-Ae^{i\psi} + Be^{-i\psi}). \end{aligned} \tag{16}$$

We shall use the ratio

$$y_{0r} = \frac{\overline{G}_n(k_r r)}{G_n(k_r r)} \tag{17}$$

as a normalized characteristic admittance for radial transmission. If a cylindrical cavity is terminated at $r = r_b$ by a wave admittance $\overline{Y}_b$, we "normalize" this admittance as follows:

$$\eta_b = \frac{\overline{Y}_b}{y_{0b}\cdot Y_0}. \tag{18}$$

At $r < r_b$ the input admittance of the cavity so terminated is

$$\overline{Y}_r = y_{0r}\cdot Y_0\frac{j\sin(\psi_b - \psi) + \eta_b\cos(\theta_b - \psi)}{\cos(\psi_b - \theta) + j\eta_b\sin(\theta_b - \theta)}. \tag{19}$$

This relation is analogous to a well-known formula for the admittance of a uniform transmission line or waveguide of characteristic admittance Y_{0G} terminated by an admittance Y_b at $x = b$.

$$Y(x) = Y_{0G}\frac{j\sin k(b - x) + Y_b/Y_{0G}\cos k(b - x)}{\cos k(b - x) + jY_b/Y_{0G}\sin k(b - x)}. \tag{20}$$

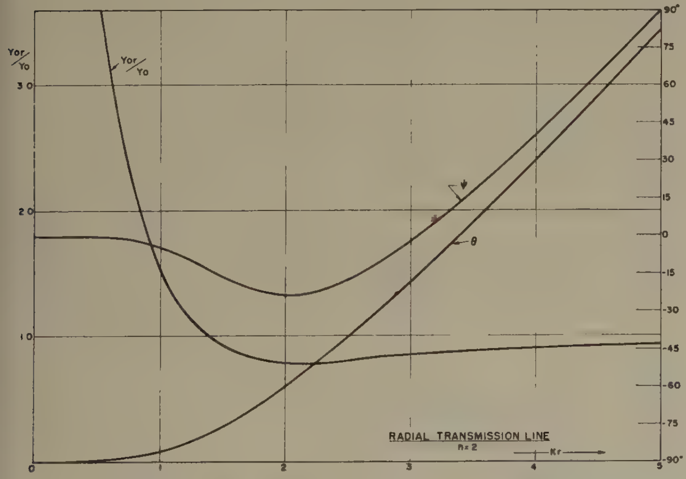


Fig. 8—Graph of y_{0r}, ψ and θ for $n = 2$.

However, the latter can be somewhat simplified by introduction of tan $k(b - x)$. A similar operation is not possible in (19) since the arguments of the trigonometric functions are all different.

Fig. 8 shows the variation of y_{0r}, ψ and θ with $k_r\cdot r$ for the second-order Hankel function corresponding to the second-order cavity mode in which the present resonator is designed to operate.[12]

4. CALCULATION OF THE RESONATOR CHARACTERISTICS

The important resonator characteristics are resonance frequency, internal and external Q, and driving-point admittance at the anode segments.

Because of considerations of frequency stability the resonator Q of a magnetron is usually chosen to be 100 or larger. Under such conditions the resonance frequency can be calculated with a reasonable accuracy without regard to the external load and losses in the cavity. The equivalent waveguide is thus considered short-circuited at $r = r_b$. The fundamental resonance occurs at the lowest frequency for which the total susceptance at a convenient surface, for example $r = r_{a1}$, is zero.

$$\begin{aligned} \frac{\omega C_f}{2}\cdot\frac{h}{\pi r_{a2}} + \overline{B}_{fm} - y_{0a2}\cdot Y_0\frac{\cos(\theta_b - \psi_{a2})}{\sin(\theta_b - \theta_{a2})} \\ - \frac{r_{a1}}{r_{a2}}\cdot y_{0a1}\cdot Y_0\frac{\cos(\psi_{a1} - \theta_k)}{\sin(\theta_{a1} - \theta_k)} = 0, \end{aligned} \tag{21}$$

where C_f is approximately equal to the electrostatic capacitance of the finger system and $\overline{B}_{fm}$ is the wave susceptance due to the magnetic energy storage associated with the finger system.[13] The symbol h denotes the axial height of the cavity. The last term represents the interaction space and is (for $n = 2$) by far the largest inductive susceptance. This suggests that a correction for the end spaces (E in Figs. 1 and 7) may be rather important. However, space does not permit a discussion of this point here; the reader is referred to a more complete presentation elsewhere.[5]

For calculation of Q the energy storage in the resonator is required. This is obtained from volume integrals of the squared electric and magnetic field intensities, respectively. For the annular space between r_k and r_{a1}, the electric energy storage is

$$\begin{aligned} W_{E1} = \frac{1}{4}\,\epsilon_0\pi h\mathcal{E}_a{}^2\Bigg\{r_{a1}{}^2\Bigg[1 - \left(\frac{n}{kr_{a1}}\right)^2 \\ + \left(\frac{\overline{G}_n(kr_{a1})\cos(\psi_{a1} - \theta_k)}{G_n(kr_{a1})\sin(\theta_{a1} - \theta_k)}\right)^2\Bigg] \\ - r_k{}^2\left(\frac{\overline{G}_n(kr_k)\cos(\psi_k - \theta_k)}{G_n(kr_{a1})\sin(\theta_{a1} - \theta_k)}\right)^2\Bigg\}, \end{aligned} \tag{22}$$

where $\mathcal{E}_a$ is the axial electric field at $r = r_{a1}$. The electric energy storage in the cavity external to the finger system is obtained from the same equation by replacing subscripts $a1$ and k by $a2$ and b, respectively. From the total electric energy storage in interaction space, finger system, and external cavity we can calculate an equivalent total capacitive wave susceptance $\overline{B}_E$ at $r = r_{a2}$.

---

[12] Corresponding graphs for $n = 0$, 1 and 3 are given in footnote reference 5.

[13] Expressions for calculations of C_f and $\overline{B}_{fm}$ are given in footnote references 5 and 2.

$$\omega W_E = \tfrac{1}{2}\mathcal{E}_a{}^2 \cdot \overline{B}_E \cdot 2\pi r_{a2} \cdot h \tag{23}$$

and

$$Q_L = \frac{\overline{B}_E}{\overline{G}_{a2}}, \tag{24}$$

where $\overline{G}_{a2}$ is the desired value of the wave conductance at the anode.

A complete evaluation of a resonator design requires also calculation of the copper losses, internal Q, and circuit efficiency. However, for lack of space the formulas for the copper losses are omitted here as being of secondary importance to the problem under study.[5]

5. Design Procedure

Given a configuration of anode fingers, interaction space, and external annular cavity that is compatible with the desired dimensions of the electronic system and satisfies the resonance equation (21) at the desired frequency, we meet the problem of designing the impedance transforming system so that the conductance between the anode segments (the slot conductance) is reasonably close to the optimum value for the electronic operation.

The optimum slot conductance is conveniently given for an ideal π-mode, that is, for π radians phase difference between the rf voltage across consecutive slots and equal voltage magnitude across all slots. In those interdigital magnetrons where the circumferential mode number $n>0$ the slot voltage varies from a maximum value E_a at certain slots to zero at other slots. An expansion of this slot voltage in space harmonics gives one component equivalent to a π-mode voltage

$$E_\pi \cong \tfrac{1}{2}\mathcal{E}_a \cdot h, \tag{25}$$

where $\mathcal{E}_a$, as before, is the axial electric field strength at a point on the circumference of the finger system where it is a maximum. Equation (25) concerns a uniform arrangement of the fingers (Fig. 2(a)). If the phase reversals at the nodes are introduced (Fig. 2(B)) and the tube is operated with the value of n (here $=2$) for which it is designed,

$$E_\pi \cong \frac{2}{\pi}\mathcal{E}_a h. \tag{26}$$

A relation between the π-mode slot conductance G_π and the wave conductance of the cavity is obtained by setting the power delivered by the electrons equal to the power transmitted by the cavity. We assume that only the π-component of the slot voltage exchanges any appreciable power with the electrons in the interaction space

$$\tfrac{1}{2}E_\pi{}^2 G_\pi = \tfrac{1}{2}\overline{G}_a r_{a2} \cdot h \int_0^{2\pi} (\mathcal{E}_a \sin n\phi)^2 d\phi \tag{27}$$

$$\overline{G}_a \cong \frac{4h}{\pi^3 r_{a2}} \cdot G_\pi \qquad (n > 0). \tag{28}$$

If the copper losses in the resonator produce a conductance component $\overline{G}_d$, the desired slot conductance will lead to a circuit efficiency

$$\eta_c = \frac{\overline{G}_a - \overline{G}_d}{\overline{G}_a}. \tag{29}$$

If this figure proves to be too low, it is necessary either to redesign the electronic system so that a larger value of $\overline{G}_a$ can be permitted or to reduce the loss conductance of the resonator.

At this point the question should also be considered whether or not this optimum load $\overline{G}_a$ gives a resonator Q sufficient for reasonable frequency stability.

The impedance transformation from the waveguide, terminated in its characteristic impedance, to the conductance $\overline{G}_a$ at the anode takes place in four steps: two discontinuity transformations at the boundaries waveguide-to-transformer and transformer-to-cavity, respectively, and in two transmission-line sections, i.e., the transformer and the cavity external to the fingers. The desired impedance ratio is achieved primarily by adjustment of the height $2h_t$ of the transformer section.

The discontinuity relations reviewed in a previous section and the transformation relations (19) and (20) furnish the tools required. Conveniently, a first approximate solution is obtained by considering only one mode in each system and no susceptances at the discontinuities. The junction between cavity and transformer is treated as two-dimensional. Using the transformer height so determined we evaluate the discontinuity susceptances and apply the result of the three-dimensional treatment of the cavity-transformer discontinuity and obtain a different value for $\overline{G}_a$. Since $\overline{G}_a$ is roughly inversely proportional to the square of h_t, this quantity can now be readjusted so as to give the desired value of $\overline{G}_a$.

6. Model Tests

In order to check the calculation procedure presented above a model cavity of the design and dimensions shown in Fig. 1 was subjected to a series of measurements. The cavity was designed to operate in the second-order mode ($n=2$). Due to an error in the original calculations the height of the transformer was made too small, thus causing the external Q to become very unrealistic and the circuit efficiency extremely poor. For the purpose of comparing measured and calculated data, however, this is unimportant. Before tests were concluded, the transformer section was redesigned to obtain a more realistic result in the last measurements.

Table I shows corresponding measured and calculated data for the test models. The column marked $\frac{1}{2}\epsilon_B$ indicates the error in resonance frequency. Because of the transcendental nature of the resonance equation the following indirect method was used to obtain this figure. At the *measured* resonance frequency the sum of the inductive susceptance and the sum of the capacitive susceptance at the radius of the finger system were calculated. Half the difference between these two sums in per cent is very nearly equal to the difference in percent between the measured frequency and the frequency that satisfies the resonance equation with the calculated susceptances.

In the Q-measurements the standing-wave ratio was measured to 0.5 db, or 15-per cent accuracy. Since in each case a curve of standing-wave ratio versus wavelength was plotted, the Q-values obtained from the measurements are probably somewhat more accurate than this figure indicates.

The computational errors may amount to a few per cent since a slide rule was used throughout and the calculations were rather lengthy, involving rationalization of complex fractions, and so on.

The largest discrepancy between the measured and computed values is about 15 per cent. The maximum error in the calculations consequently is ±30 per cent and the probable error considerably smaller than that, which is the best confirmation obtainable with the instrumentation employed.

TABLE I

Test cavity	Transformer height	Observed data			Calculated		
		λ_0	Q_E	Q_0	$\frac{1}{2}\epsilon_B$	Q_E	Q_0
Model A	0.254	9.34	3360	450	1.35%	3820	445
Model B	0.254	9.92	2700	510	<1%	3000	500
Model B	0.810	9.93	368	550	<1%	312	500

It is interesting to compare the numerical results obtained in the first approximation where the change from cylindrical to plane waves was disregarded, with those obtained in the final calculations, where the transformation from plane to cylindrical waves was applied. The first-mentioned procedure gave the following values of Q_E in the same order as given in Table I, 1780, 1830, and 190, or not much more than half of the observed values.

The numerical calculations for a second-order-mode resonator gives some interesting information about energy distribution and losses in the resonator. It is not unexpected, of course, that about 90 per cent of the electric energy storage takes place in the immediate vicinity of the finger system. More remarkable is that the magnetic energy storage is about twice as large in interaction space as in the cavity external to the finger system. The finger system itself and the higher-order-modes in its vicinity account for 25 to 30 per cent of the magnetic energy storage. About 60 to 70 per cent of the copper losses occur in the fingers, because these are immersed in the RF magnetic field in a region of the resonator where both the radial and azimuthal components have their maximum values. If the same resistivity is assumed, the cathode surface accounts for another 15 to 20 per cent. Since the losses increase with the square root of the resistivity, this item may in an actual tube become an appreciable part of the total (the cathode surface has appreciably lower conductivity than copper). At room temperature, tungsten and molybdenum would give more than twice the loss of copper, and at normal operating temperature considerably more. The loss in the cavity external to the finger system was found to be 10 per cent or less of the total. The losses in the end walls or the interaction-space extensions were found to be small compared to those previously mentioned.

7. CONCLUSION

The procedure presented in this paper for calculation of the impedance transformation between the anode segments of an interdigital magnetron and a waveguide load and for the design of an appropriate transformer is roughly verified by the model tests, the purpose of which was primarily to give confidence that the main principles of the method are sound and that no important factors in the problem have been overlooked. For a closer evaluation of the accuracy we have to estimate the errors in the individual steps of the procedure produced by the approximations and the simplifying assumptions made. The most radical of these concern the finger system and affect the resonance frequency, copper losses, and the energy storage but not directly the impedance transformation. Neglect or rough approximations of the contributions from higher-order modes at the various junctions are other sources of errors, which can be estimated in each case. An interesting observation is that failure to apply the proper transformation between cylindrical waves in the cavity and plane waves in the waveguide leads to an unexpectedly large error.

* * *

The Effective Number of Pulses Per Beamwidth for a Scanning Radar*

LAMONT V. BLAKE†, MEMBER, IRE

Summary—**The effective number of pulses received when a radar scans past a target is analyzed in terms of the integration of a train of pulses of amplitudes determined by the antenna beam pattern. It has been customary to take for this number the pulses occurring in the half-power beamwidth, β, and to assume that these pulses were all of full (mid-beam) amplitude (this assumption roughly compensating for the discard of pulses outside the half-power points). The present analysis is based on the existence of an optimum integration angle, which gives a greater improvement of signal-to-noise ratio than integration over greater or lesser arcs. This optimum is found to be 0.84β for a Gaussian-shaped beam. Integration over this angle gives the same signal-to-noise improvement as integration over a rectangular-shaped beam of width 0.47β. Thus the equivalent number of full-amplitude pulses is 0.47 times the number usually assumed, representing a reduction in calculated radar system sensitivity of 1.6 db.**

INTRODUCTION[1]

WHEN A SCANNING RADAR of beamwidth β, angular scanning speed ω, and pulse repetition frequency F scans past a point target, it is customary to assume that a train of n pulses is received from the target, and that $n=\beta F/\omega$. This assumption is based on idealization of the antenna beam pattern—that is, it is assumed that the beam has uniform gain over an angle β, and zero gain elsewhere. In the real case, the gain is variable and a reasonable representation of the variation is the Gaussian or "error" function. The beamwidth is defined as the width of this function between half-power points, or 0.707-voltage points.

The assumed "number of pulses" figures in the calculation of system sensitivity and range of detection—specifically, it affects the calculation of the minimum detectable signal level, because of the effect of integration.[2] Briefly, this means that the "received signal" consists of the net effect of the train of pulses. In general the resultant signal-to-noise ratio increases with number of uniform-amplitude pulses integrated (though not necessarily linearly).

The procedure of taking as the number of pulses received those between half-power points of the beamwidth is obviously an arbitrary one. Pulses of reduced amplitude are received far out from the beam center, the amplitude varying with angle, θ, according to some function which is here assumed to be of the form $e^{-k\theta^2}$. The two questions to be answered are: (1) how many of these pulses are actually integrated, i.e., how far out on the edges of the beam do the pulses actually contribute to the "signal" observed by the radar operator; (2) what is the signal-to-noise ratio resulting from this integration of many pulses of different amplitudes, and what "rectangular"-shaped beamwidth would give this same signal-to-noise ratio after integration?

DISCUSSION OF RESULTS

On the basis of some reasonable assumptions concerning the nature of the integration process, it has been found possible to answer these questions. The result obtained is that the equivalent rectangular beamwidth is 0.47 times the half-power width of a Gaussian-shaped beam. Hence the equivalent number of full-amplitude pulses integrated is 0.47 times the number usually assumed. On the basis that minimum detectable signal power varies inversely as the square root of the number of pulses integrated, the system sensitivity computed on this new basis compared with the former assumption (as to number of pulses integrated) is smaller by the factor $\sqrt{0.47}=0.69$ (equivalent power ratio). This is about 1.6 db. Thus a "correction" of 1.6 db for this effect may be applied to computations of system sensitivity already made on the previous basis.

The answer obtained to the first of the two questions—namely, how far out from the beam center can the integration process be carried profitably—is 0.84 times the distance out to the half-power point. This means that integration out to this point gives an improvement in signal-to-noise ratio greater than the improvement obtained by integrating over lesser or greater portions of the beam. There is, in other words, an optimum "integration angle." The explanation of this phenomenon in general terms is that in any integration process the noise as well as the signal is being integrated, and the process is profitable only so long as it favors the build-up of signal compared to the build-up of noise.[3] Inasmuch as the signal amplitude is getting smaller and smaller with angular distance from the beam center, while the noise is remaining constant in amplitude, it is easy to see why the integration process should not be carried too far. On the other hand, it is probably also obvious that, near the beam center where the slope of signal amplitude versus angle is small, integration will be beneficial. Obviously then there is somewhere an op-

---

* Decimal classification: R537.11. Original manuscript received by the Institute, August 8, 1952; revised manuscript received December 29, 1952.

† Naval Research Laboratory, Washington 25, D. C.

[1] Since this paper was submitted for publication it has come to the writer's attention that some work similar to this in some respects was done at the Sperry Gyroscope Co., in 1948. This work was described in a report which contained other material requiring it to be security-classified, and it is therefore not available to the public. The author's name was not given. So far as is known, this work has not been published. Although the work described here was done completely without knowledge of the Sperry work, and appears to be essentially different in many respects, apology is offered to the unknown author of the Sperry report for the similarities.

[2] If this is not a familiar concept, an excellent discussion may be found in vol. I of the M.I.T. Radiation Laboratory Series, "Radar System Engineering," pp. 41–47, Section 2.11 ("Effect of storage on radar performance").

[3] *Ibid.*, for explanation of why the two build up differently so as to favor the signal when the pulses are of constant amplitude.

timum stopping point, which our analysis has shown to be 0.84 of the distance from the beam center to the half-power point.

In going from this result to an "equivalent rectangular beamwidth" it is of course assumed that the observer somehow has the ability to integrate only over this optimum angle. Possibly this is not too rash an assumption. One can at least imagine that an observer automatically varies his "observation angle" over a reasonable range, in an attempt to detect signals, and that this range would include the optimum angle. At any rate, it is necessary to make the assumption in order to make a mathematical analysis. Moreover, the result obtained is, if not correct, on the optimistic side, meaning that the system-sensitivity correction factor may be greater than 1.6 db, but not less (insofar as this particular possible source of error is concerned).

MATHEMATICAL FORMULATION AND SOLUTION OF THE PROBLEM

The one-way antenna voltage gain pattern for an assumed Gaussian[4] beam shape is:

$$G_1(\theta) = e^{-0.347(\theta/\theta_1)^2}, \tag{1}$$

where θ is angle measured with respect to the beam center, θ_1 is the co-ordinate of the half-power (0.707 voltage) point, and the gain is normalized to unity at mid-beam. (The "half-power beamwidth" is $2\theta_1$.)

For two-way (radar) propagation this becomes

$$G_2(\theta) = G_1{}^2(\theta) = e^{-0.694(\theta/\theta_1)^2}. \tag{2}$$

The integration process we are concerned with occurs after detection (demodulation). Since we are concerned with small signals in any discussion of minimum levels of discernibility, the effect of the detector on low signal levels (relative to the noise level) must be taken into account. This is approximately a square-law effect[5] (even for a so-called linear detector), and so the law of variation of signals as a function of position in the beam, as finally observed in the receiver output, is

$$G_3(\theta) = G_2{}^2(\theta) = e^{-1.387(\theta/\theta_1)^2}. \tag{3}$$

The effect of the integration process is analyzed in terms of its effect on signal-to-noise ratio. After detection (demodulation), the measure of signal-to-noise voltage ratio may be taken to be[6]

$$R = \frac{\overline{E}_{S+N} - \overline{E}_N}{\sigma_N}, \tag{4}$$

where $\overline{E}_{S+N}$ is the average value of signal-plus-noise, $\overline{E}_N$ is the average value of the noise is the absence of a signal, and σ_N is the root-mean-square deviation from the mean (standard deviation) of the fluctuations of noise. In this expression we may call $(\overline{E}_{S+N}-\overline{E}_N)$ the "signal."

By an integration process it is meant that the effect of successive signals (and noise) is additive. It is a well-known theorem of mathematical probability theory that the average value of the sum of n random variables is equal to the sum of the average values. Hence for the integration of n pulses all having the same average value the numerator of (4) is multiplied by n. On the other hand, the standard deviation of the sum of n random variables is equal to the square root of the sum of the squares of the individual standard deviations. Hence for the integration of n noise voltages the denominator of (4) is increased by the square root of n. This leads to the well-known result that R is increased by the square root of n; this is the improvement in video signal-to-noise voltage ratio obtained by video integration of n pulses all having the same amplitude. Because of the square-law relation between small values of predetection and postdetection signal-to-noise ratios, the equivalent predetection improvement factor is $n^{1/4}$. This refers to voltage signal-to-noise ratio. The equivalent predetection signal-to-noise power ratio improvement is therefore $n^{1/2}$. This is the form in which experimental work confirming this result has usually been expressed.

When the integrated pulses are varying in amplitude in accordance with the beam pattern, the "signal" $S=\overline{E}_{S+N}-\overline{E}_N$ is a variable, following the law of (3). (It is the quantity S which varies as the square of the predetection signal level, for signals of the order of the noise or smaller.) That is,

$$S(\theta) = S(0)e^{-1.387(\theta/\theta_1)^2}. \tag{5}$$

Designating $S(0)$ as S_0 and assuming a high "density" of pulses, the result of integrating from an angle $-\theta_2$ to $+\theta_2$ is

$$\begin{aligned} R &= \frac{k\displaystyle\int_{-\theta_2}^{\theta_2} S_0 e^{-1.387(\theta/\theta_1)^2} d\theta}{\left[k\displaystyle\int_{-\theta_2}^{\theta_2} \sigma_N{}^2 d\theta\right]^{1/2}}, \\ &= R_0\sqrt{\frac{2k}{\theta_2}}\int_0^{\theta_2} e^{-1.387(\theta/\theta_1)^2} d\theta \end{aligned} \tag{6}$$

where $R_0=S_0/\sigma_N$. Here k is the pulse density, in pulses per unit angle. That is, if the pulse rate is F and the scanning speed ω, $k=F/\omega$. The number of pulses integrated in the interval $-\theta_2$ to $+\theta_2$ is of course $2k\theta_2$.

(The assumption of high pulse density is necessary to justify the use of an integral representation of the sum. It is shown later that this representation also gives valid results for low-pulse-density cases. It represents, for such cases, the statistical average result, which is in fact the only generally meaningful and useful result that could be obtained.)

---

[4] The representation of antenna beam shape by the Gaussian function is based on empirical studies of practical antenna beams. This representation is typically valid over at least the range of beam arc of interest here.

[5] This is the effect of "suppression" of weak signals by noise, not to be confused with an actual nonlinearity of the detecting device, such as may occur with small input voltages. The effect considered here is much more fundamental and occurs when signals are small relative to the noise, regardless of the actual values of voltage involved. See W. R. Bennett, "Response of linear rectifier to signal and noise," *Bell Sys. Tech. Jour.*, vol. 23, pp. 97–113; January, 1944.

[6] This concept of post-detection signal-to-noise ratio was proposed by the writer in an appendix to NRL report R-3123, September, 1947. It is also proposed in "Threshold Signals," by Lawson and Uhlenbeck, McGraw-Hill Book Co., New York, N. Y., pp. 161–163; 1950.

Therefore, the improvement relative to the mid-beam single-pulse signal-to-noise ratio is

$$A = R/R_0 = \sqrt{\frac{2k}{\theta_2}} \int_0^{\theta_2} e^{-1.387(\theta/\theta_1)^2} d\theta. \tag{7}$$

The object of this analysis is to discover, if possible, the value of θ_2 which results in a maximum value of A. Mathematically this corresponds to the condition

$$\frac{dA}{d\theta_2} = 0. \tag{8}$$

Physical reasoning indicates that if a solution to (8) exists it will correspond to a maximum value of A, and not a minimum, and that there will be only one maximum.

From (7) we get

$$\frac{dA}{d\theta_2} = \sqrt{\frac{2k}{\theta_2}} e^{-1.387(\theta_2/\theta_1)}$$

$$- \frac{1}{\theta_2{}^{3/2}} \sqrt{\frac{k}{2}} \int_0^{\theta_2} e^{-1.387(\theta/\theta_1)^2} d\theta, \tag{9}$$

and setting the right side equal to zero gives

$$2\theta_2 e^{-1.387(\theta_2/\theta_1)^2} = \int_0^{\theta_2} e^{-1.387(\theta/\theta_1)^2} d\theta. \tag{10}$$

It will be noted that the k has now dropped out, indicating that the value of θ_2 giving maximum A does not depend on k, although the assumption that $k\theta_1$ is large is retained.

The integral on the right is of the form of the well-known error function which is tabulated, and hence a graphical solution to (10) may be obtained. This yields

$$\theta_2 = 0.844\theta_1 \tag{11}$$

as the optimum value.

The next step is to calculate the "equivalent rectangular beamwidth." For a rectangular beam, of width 2Φ, the integration improvement factor would be $\sqrt{2k\Phi}$ (the number of pulses integrated would be $2k\Phi$). We therefore write (from 7)

$$\sqrt{2k\Phi} = \sqrt{\frac{2k}{\theta_2}} \int_0^{\theta_2} e^{-1.387(\theta/\theta_1)^2} d\theta. \tag{12}$$

Putting in the value $\theta_2 = 0.84\theta_1$ and solving for Φ gives $2\Phi = 0.473(2\theta_1)$ as the equivalent rectangular beamwidth. This represents a reduction of radar sensitivity of 1.6 db compared to the assumption of a rectangular beam of width $2\theta_1$.

VALIDITY FOR LOW-PULSE DENSITY

As has been pointed out, the foregoing results apply statistically to low-pulse-density as well as high-pulse-density cases. Inasmuch as it is quite likely that practical applications to low-pulse-density cases will occur, a proof of applicability is presented. This proof was worked out by W. S. Alderson of the Naval Research Laboratory.

Suppose that the total angular interval from $-\theta_2$ to $+\theta_2$ contains $(n+1)$ pulses (an odd number) separated by angular intervals of width $\Delta\theta$. Within the range $-\theta_2$ to $+\theta_2$ the set of $(n+1)$ pulses may take an infinite number of positionings (that is, any one of the pulses may have a position anywhere within the interval $\Delta\theta$). On any one scan of the radar a particular positioning will occur, and a particular value of R will be observed (see (4), (6), and (18)). For purposes of computing radar sensitivity or maximum range, the average value of R over a great many observations (or scans) is required.

On any single scan, let the pulses occurring in the interval $-\theta_2$ to $+\theta_2$ be numbered from $-n/2$ to $+n/2$. Let the angular position of the j^{th} pulse be α_j. Using notation similar to that of (6), the amplitude of the j^{th} signal pulse after detection may be denoted as $S(\alpha_j)$. Then the integrated signal-to-noise ratio after detection, as given for a low-pulse-density case by (18), will be

$$R = \frac{\sum_{j=-n/2}^{n/2} S(\alpha_j)}{\sqrt{n+1}\,\sigma}, \tag{13}$$

where σ is the rms noise voltage.

This result holds for any particular positioning of the pulses. The average over all possible positionings may be written

$$\overline{R} = \frac{1}{\sqrt{n+1}\,\sigma} \overline{\sum_{j=-n/2}^{n/2} S(\alpha_j)}. \tag{14}$$

If one interval $\Delta\theta$ is sub-divided into N equally spaced sub-intervals, so that the m^{th} sub-interval of the j^{th} interval is located at angular position α_{jm}, we may write

$$\begin{aligned} \overline{\sum_{j=-n/2}^{n/2} S(\alpha_j)} &= \lim_{N\to\infty} \frac{1}{N} \sum_{m=1}^{N} \sum_{j=-n/2}^{n/2} S(\alpha_{jm}), \\ &= \sum_{j=-n/2}^{n/2} \left[\frac{1}{\Delta\theta} \int_{(j-\frac{1}{2})\Delta\theta}^{(j+1/2)\Delta\theta} S(\theta)\, d\theta \right], \\ &= \frac{1}{\Delta\theta} \int_{-\theta_2}^{\theta_2} S(\theta)\, d\theta. \end{aligned} \tag{15}$$

Hence

$$\overline{R} = \frac{\frac{1}{\Delta\theta} \int_{-\theta_2}^{\theta_2} S(\theta)\, d\theta}{\sqrt{n+1}\,\sigma}. \tag{16}$$

Here $1/\Delta\theta$ corresponds to the "pulse density," k, in (6). Similarly the quantity $(n+1)$ can be re-written as $(2k\theta_2)$ giving

$$\overline{R} = \frac{k\int_{-\theta_2}^{\theta_2} S(\theta)d\theta}{\sqrt{2k\theta_2}\,\sigma}, \tag{17}$$

which is seen to be essentially (6). Thus it has been demonstrated that this equation applies to low-pulse-density cases, in a statistical average sense, as well as to high-pulse-density cases.

This proposition has been proved rigorously here only for the case where $(n+1)$ is odd and $2\theta_2=(n+1)\Delta\theta$. It is also true when the number of pulses integrated is even, and for "integration angles" that are not integral multiples of $\Delta\theta$, but it was felt that the additional proof would not be of sufficient value to the reader to justify its inclusion.

APPENDIX

DIRECT ANALYSIS OF LOW-PULSE-DENSITY CASE

When the analysis of this paper was first made, using integral representation of the integration process and thus assuming high pulse density, it was suspected that the result was applicable in a statistical sense to low-pulse-density cases, but the proof of this was not worked out until later. Therefore a direct analysis of the low-pulse-density case was made. Because the results of this analysis give an insight into what will occur on *any one scan* of a low-pulse-density radar (as contrasted with what happens statistically or on the average), a brief sketch of this analysis is presented.

For low-pulse densities the integral representation of the integration process must be replaced by a summation expression. Moreover, it is necessary to assume some particular positioning of the pulses within the beam. Actually all possible positions will occur. Two possible ones which are symmetrical were assumed, as indicated in the following diagrams.

That is, in Case 1, one of the pulses is assumed to fall at the exact beam center. If the angular spacing of the pulses is ϕ, then the other pulses fall at $\theta=\pm\phi, \pm 2\phi, \pm 3\phi \cdots$. In Case 2, there is no pulse at the center but the pulses are symmetrically positioned with respect to the center—that is, they fall at $\theta=\pm\phi/2$, $\pm 3\phi/2$, $\pm 5\phi/2, \cdots$.

The expressions corresponding to (7) for these two cases are:

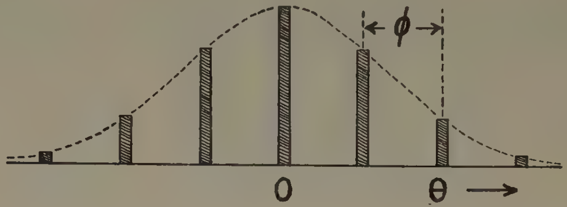
Case 1:

$$A_1 = \frac{1 + 2\sum_{m=1}^{(n-1)/2} e^{-1.387(m\phi/\theta_1)^2}}{\sqrt{n}}, \tag{18a}$$

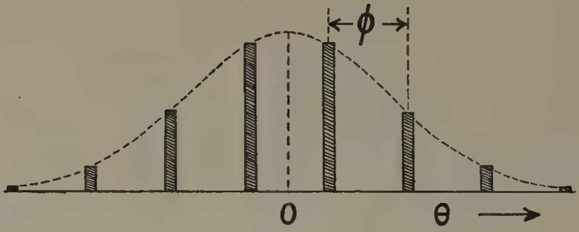
Case 2:

$$A_2 = \frac{2\sum_{m=1}^{n/2} e^{-1.387[(2m-1)\phi/2\theta_1]^2}}{\sqrt{n}}, \tag{18b}$$

where n is the number of pulses integrated.



Case 1



Case 2

Expressions of this kind cannot be differentiated with respect to n unless the summations can somehow be put into closed form. This does not appear to be directly possible, in terms of any known functions. However, it is possible if the Gaussian function is approximated, over the range of values of interest, by a second degree parabola.

A sufficiently good approximation is[7]

$$e^{-1.387x^2} \cong 1 - 0.28x - 0.54x^2. \tag{19}$$

Substituting this approximation in (18a) and (18b) gives expressions in which the summation terms can be evaluated and put into closed forms. These expressions can then be differentiated with respect to n, and the result set equal to zero, giving the following relations for maximum improvement in signal-to-noise ratio, corresponding to Cases 1 and 2, respectively:

$$n^3 + 0.935(\theta_1/\phi)n^2 - [4.44(\theta_1/\phi)^2 + 0.2]n + 0.311(\theta_1/\phi) = 0, \tag{20a}$$

$$n^2 + 0.935(\theta_1/\phi)n - [4.44(\theta_1/\phi)^2 + 0.2] = 0. \tag{20b}$$

It is worth noting that if (20a) is divided through by n, the result indicates that (20a) and (20b) become approximately the same for large values of n, as they should. When n is large, in fact, these equations should lead to the same result as was obtained from (10). When the pulse density is high, (20a) and (20b) can be expressed in terms of a variable $u=(n\phi/\theta_1)$, taking into account the assumptions $n \gg 1$, $\phi/\theta \ll 1$, and $(n\phi/\theta_1)$ is of the order of 1. The resulting expression is

---

[7] This was obtained by expanding $e^{-1.387x^2}$ in the first three terms of a series of Legendre polynomials, which can be shown to give a result satisfying the "least squares" criterion. I am indebted to Dr. L. G. McCracken for suggesting this method. The value 1 for the zero-order term may seem somewhat improbable as a least-square-fit value. It was obtained by slide-rule computation and is therefore not exact, but a more accurate computation was deemed unnecessary because of the good results obtained with these values of the coefficients.

$$u^2 + 0.935u - 4.44 = 0, \tag{21}$$

for which the solution is $u=1.698$. In the symbols of (6) through (12), this means $\theta_2=0.849\ \theta_1$. Comparing this with (11), it is seen that the two results are in very good agreement. That the agreement is not exact would be expected in view of the approximation (19).

ACKNOWLEDGMENT

The need for a solution to this problem was pointed out to me by Mr. A. A. Varela of the Naval Research Laboratory. I am also indebted to Mr. Varela for helpful discussions during my work on the problem.

A Note on Moving Poles in Nonlinear Oscillating Systems*

WILLIAM B. WRIGLEY†, ASSOCIATE, IRE

Summary—**Since poles of the complex immittance of a linear system represent the decrements and frequencies of rotating phasors in the linear time domain, it is suggested that a nonlinear system might be represented by moving poles whose instaneous decrements and frequencies are associated with phasors rotating in the nonlinear or time-distorted phase space. This idea is applied to the analysis of a class of nonlinear oscillation generators of the second order which is described by the differential equation, $\ddot{X}-N_1(\dot{X},\ X)=0$.**

ONE CLASS of oscillation generators of the second order is described by the nonlinear differential equation

$$\ddot{X} - N_1(\dot{X}, X) = 0. \tag{1}$$

This is a normalized representation of a two-terminal system in which oscillations may be sustained by a nonlinear resistance or conductance (i.e., dynatron) and which also may include a nonlinearity in either the capacitance or inductance element.

Such systems can be studied graphically by the method of isoclines, and many writers have dwelt at considerable length on this subject. A most readable discourse was presented by Le Corbeiller in 1935.[1] The present author became intrigued with the possibility that the phase space ($\dot{X}$ versus X) of the isocline construction might be related to the complex immittance or frequency domain of the LaPlace transformation.

Since poles of immittance in the complex domain represent the decrements and frequencies of rotating phasors in the linear time domain, it follows that a nonlinear system might be represented by moving poles whose instantaneous decrements and frequencies are associated with phasors rotating in the nonlinear or time-distorted phase space. This would suggest a "solution" to (1) of the type

$$X(t) = r_0 e^{\int_0^t \sigma dt} \cos\left(\int_0^t w dt + \theta_0\right), \tag{2}$$

where

$$\sigma = \sigma(t) \quad \text{and} \quad w = w(t) \tag{3}$$

describe the locus of an appropriate moving pole (the conjugate with the positive imaginary term).

First, (1) will be modified slightly to

$$\ddot{X} - N(\dot{X}, X) + X = 0, \tag{4}$$

and since

$$\ddot{X} = \dot{X}\frac{d\dot{X}}{dX}, \tag{5}$$

to

$$X = N(\dot{X}, X) - \dot{X}\frac{d\dot{X}}{dX}. \tag{6}$$

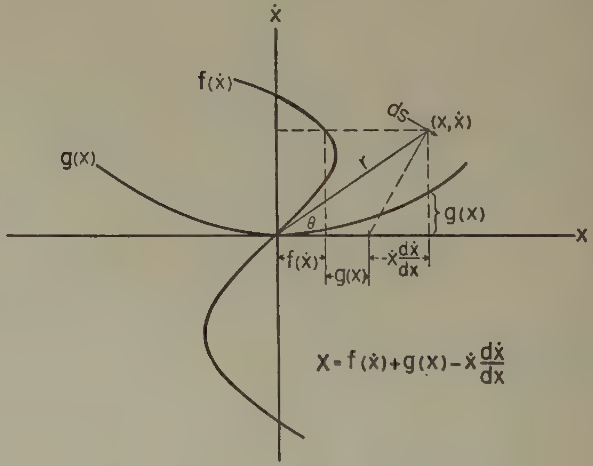

ẋ
f(ẋ)
ds
(x, ẋ)
g(x)
r
θ
g(x)
x
f(ẋ)
g(x)
$-\dot{x}\frac{d\dot{x}}{dx}$
$x = f(\dot{x}) + g(x) - \dot{x}\frac{d\dot{x}}{dx}$

Fig. 1—The isocline or phase space construction for a graphical solution to nonlinear differential equations of the type $\ddot{X}-f(\dot{X})-g(\dot{X})+X=0$.

Fig. 1 shows an isocline construction in the $\dot{X}$ versus X phase space in which ds is an increment of the locus of a phase space phasor $r=(\dot{X}^2+X^2)^{1/2}$ generating $X(t)$ the solution to (7) projected on the X axis. Since ds has a slope equal to $-d\dot{X}/dX$, it is apparent that the construction yields

$$X = f(\dot{X}) + g(X) - \dot{X}\frac{d\dot{X}}{dX}. \tag{7}$$

Now (7) differs from (6) in that a further restriction was placed on $N(\dot{X}, X)$ so that the terms involving $\dot{X}$

---

* Decimal classification: R133×510. Original manuscript received by the Institute, September 18, 1952.

† Georgia Institute of Technology, Atlanta, Ga.

[1] P. Le Corbeiller, "The nonlinear theory of the maintenance of oscillations," Proc. I.R.E., vol. 23, pp. 361–378; 1935.

and X are separable. However, this was done for graphical convenience only, and it will become obvious later that the more general class of (6) is admissible.

The decrement of $X(t)$ is

$$\sigma(t) = \frac{1}{r}\frac{dr}{dt} = \frac{1/2(\dot{X}^2 + X^2)^{-1/2}(2\ddot{X}\dot{X} + 2\dot{X}X)}{(\dot{X}^2 + X^2)^{1/2}} \tag{8}$$

$$= \frac{\dot{X}(\ddot{X} + X)}{r^2} \tag{9}$$

or, from (4),

$$\sigma(t) = \frac{\dot{X}N(\dot{X}, X)}{\dot{X}^2 + X^2} = -\frac{N(\dot{X}, X)}{r}\sin\theta, \tag{10}$$

where

$$\theta = \tan^{-1}\frac{-\dot{X}}{X}. \tag{11}$$

The angular velocity,

$$w(t) = \frac{d}{dt}\theta, \tag{12}$$

of r can be found as follows:

$$\frac{d}{dt}\tan\theta = \frac{-X\ddot{X} + \dot{X}^2}{X^2} = \sec^2\theta\frac{d\theta}{dt} = \frac{r^2}{X^2}w\cdot \tag{13}$$

Therefore,

$$w(t) = \frac{-X\ddot{X} + \dot{X}^2}{r^2} = \frac{XN(\dot{X}, X) + \dot{X}^2 + X^2}{\dot{X}^2 + X^2} \tag{14}$$

$$= -\frac{XN(\dot{X}, X)}{\dot{X}^2 + X^2} + 1 = -\frac{N(\dot{X}, X)}{r}\cos\theta + 1. \tag{15}$$

Since the angular frequency w_0 of the normalized linear conservative system is equal to 1,

$$w - w_0 = \Delta w = -\frac{N(\dot{X}, X)}{r}\cos\theta. \tag{16}$$

This indicates that the locus of the positive pole of the system in the complex immittance plane (w versus σ) is described by another phasor centered at $(\sigma, w) = (0, 1)$ and rotating in synchronism with r, the original phase space phasor. In fact, it can be seen from (10) and (16) that Δw and σ can be conveniently plotted on the original phase space isocline diagram with the Δw axis coincident with the X axis and the σ axis coincident with the $\dot{X}$ axis. Fig. 2 was constructed from the typical equation,

$$\ddot{X} - \dot{X} + \frac{\dot{X}^3}{3} + \frac{X\sqrt{X}}{2} + X = 0, \tag{17}$$

which represents an active system with a cubic resistance or conductance element and a restoring force which includes a function of the 3/2 power of the displacement. The cubic is constructed on the $\dot{X}$ axis, and the 3/2 power curve is constructed on the X axis. The isocline, which is the locus of the tip of the phase space phasor, is shown by the dashed line, and the pole path is shown by the solid line.

It can be demonstrated that (2), with expressions for σ and w from (10) and (15), is a "solution" to (4) (see Appendix A). The analytical value of such a "solution" may not be immediately apparent; however, we believe it represents a novel approach to the problem and certainly challenges one with the possibility of studying nonlinear systems through the medium of moving poles associated with a phase space time domain.

It is interesting to note that in the linear case,

$$\ddot{X} + a\dot{X} + X = 0, \tag{18}$$

the pole is still not stationary. A little algebraic manipulation between (18), (10), and (16) determines the locus of the pole to be

$$\sigma^2 + (\Delta w)^2 - a\sigma = 0, \tag{19}$$

which is a circle of radius $a/2$ centered at $(\sigma, w) = (-a/2, 1)$.

APPENDIX A

Given the nonlinear differential equation,

$$\ddot{X} - N(\dot{X}, X) + X = 0, \tag{A1}$$

it is to be shown that a solution exists of the form

$$X = r_0 e^{\int_0^t \sigma dt}\cos\left(\int_0^t w dt + \theta_0\right), \tag{A2}$$

where

$$\sigma = \sigma(t) = \frac{\dot{X}N(\dot{X}, X)}{\dot{X}^2 + X^2} \tag{A3}$$

and

$$w = w(t) = -\frac{XN(\dot{X}, X)}{\dot{X}^2 + X^2} + 1. \tag{A4}$$

Let

$$D = \dot{X}^2 + X^2 \tag{A5a}$$

$$N = N(\dot{X}, X); \tag{A5b}$$

then

$$\sigma = \frac{\dot{X}N}{D}, \tag{A6}$$

$$\dot{\sigma} = \frac{D(\dot{X}N + \ddot{X}N) - \dot{X}N\dot{D}}{D^2}, \tag{A7}$$

$$w = -\frac{XN}{D} + 1 = \frac{D - XN}{D}, \tag{A8}$$

and

$$\dot{w} = -\frac{D\dot{X}N + DX\dot{N} + XN\dot{D}}{D^2}\cdot \tag{A9}$$

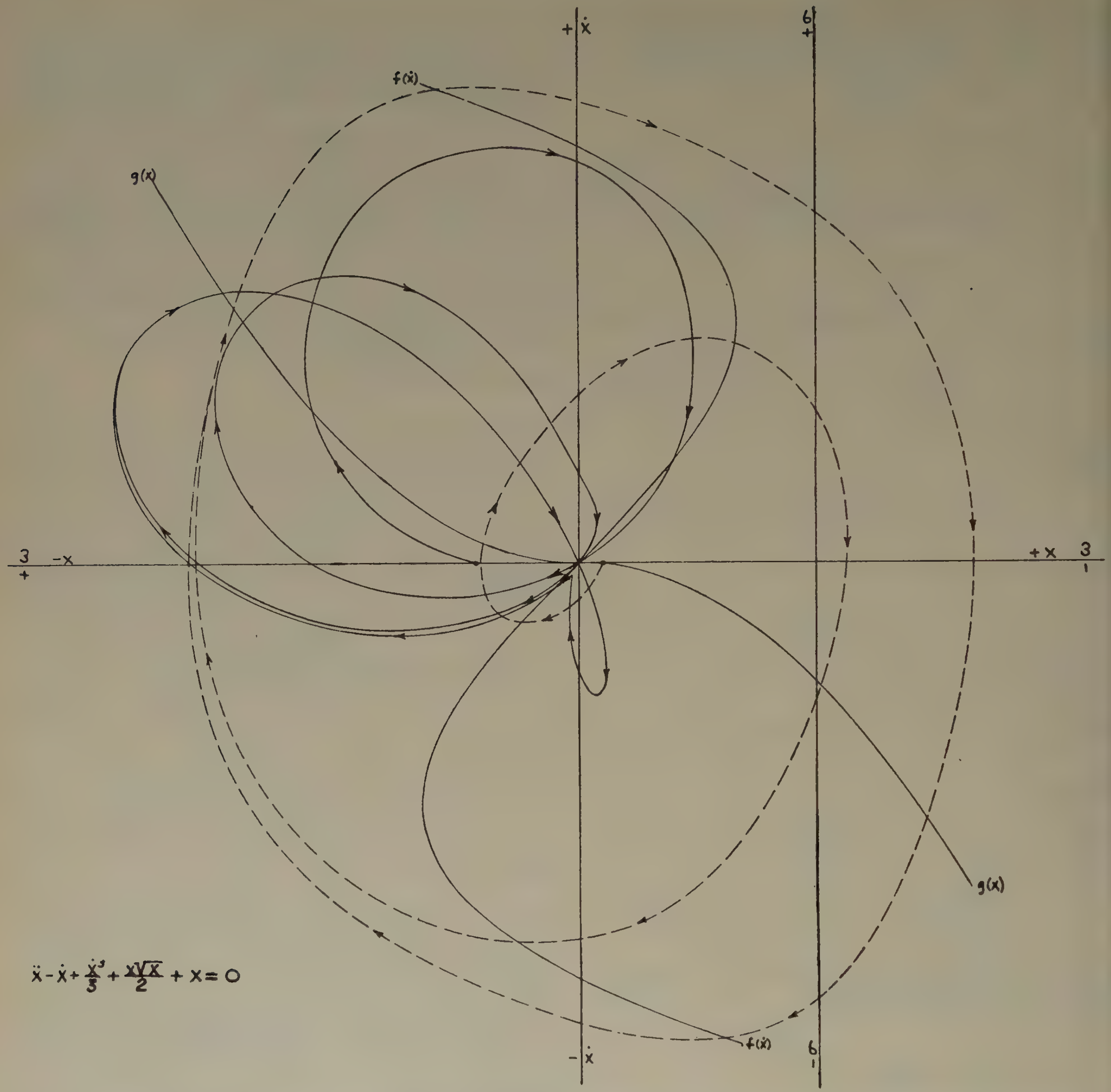


Fig. 2—The isocline graphical solution (dashed line on the $\dot{X}$ versus X axes) and the complex domain-pole path (solid line on the w versus σ axes) for an equation describing a two-terminal nonlinear oscillator.

By differentiation of (A2)

$$\dot{X} = -r_0 e^{\int_0^t \sigma dt} w \sin\left(\int_0^t w dt + \theta_0\right) + \sigma X, \qquad \text{(A10)}$$

and

$$\ddot{X} = -r_0 e^{\int_0^t \sigma dt}\left[w^2 \cos\left(\int_0^t w dt + \theta_0\right) + \dot{w} \sin\left(\int_0^t w dt + \theta_0\right)\right] - \sigma r_0 e^{\int_0^t \sigma dt} w \sin\left(\int_0^t w dt + \theta_0\right) + \dot{\sigma} X + \sigma \dot{X}, \qquad \text{(A11)}$$

which reduces to

$$\ddot{X} = X\left(-\sigma\frac{\dot{w}}{w} - w^2 - \sigma^2 + \dot{\sigma}\right) + \dot{X}\left(\frac{\dot{w}}{w} + 2\sigma\right). \qquad \text{(A12)}$$

Combining (A6) through (A9) with (A12) gives

$$\begin{aligned}\ddot{X} + X = X\Bigg\{&\left(\frac{\dot{X}N}{D}\right)\left(\frac{D\dot{X}N + DX\dot{N} - XN\dot{D}}{D^2}\right)\left(\frac{D}{D - XN}\right)\\ &+ \frac{-D^2 + 2DXN - X^2N^2}{D^2} - \frac{\dot{X}^2N^2}{D^2} + \frac{D\dot{X}N + D\ddot{X}\dot{N} - \dot{X}N\dot{D}}{D^2} + 1\Bigg\}\\ &+ \dot{X}\Bigg\{\left(\frac{-D\dot{X}N - DX\dot{N} + XN\dot{D}}{D^2}\right)\left(\frac{D}{D - XN}\right) + \frac{2\dot{X}N\dot{D}}{D^2}\Bigg\},\end{aligned}\tag{A13}$$

which reduces to

$$\ddot{X} + X = \frac{2D^3N + X^2DN^3 - 2D^2XN^2 - DN^2X^3 + D^2XN\ddot{X} - DX^2N^2\ddot{X} - D^2\dot{X}^2N}{D^2(D - NX)}.\tag{A14}$$

Since from (A5)

$$D^2\dot{X}^2N = D^3N - D^2X^2N,\tag{A15}$$

(A14) is easily reduced to the relationship

$$\ddot{X} + X = N.\tag{A16}$$

The Effects of Terminations and Dissipation on the Insertion Loss of Some Simple Ladder Filters*

M. STRASBERG†

Summary—**The use of nonstandard terminations improves the selectivity of the simple ladder filters and makes it possible to use elements of relatively low *Q*.**

Universal curves of insertion loss, indicating the combined effects of the terminations and of dissipation in the filter elements, are presented so as to apply to low-pass, high-pass, and band-pass filters for the constant-*k* half and full section and the full section terminated by *m*-derived half sections.

I. INTRODUCTION

IT IS WELL KNOWN that the selectivity of ladder-type filters is affected by the filter termination and by dissipation in the filter components. However, it is not so well known that the use of nonstandard terminations can partially counteract the harmful effects of dissipation and improve the filter selectivity. Indeed, in certain simple filters components of relatively low Q may be used, provided the filter is appropriately terminated.

The conventional formulas used for designing a ladder filter and for calculating its attenuation assume that the filter is terminated by its image impedance. Despite the variations of the image impedance with frequency, for convenience the filter is usually terminated by a constant resistance, whose value is ordinarily set equal to the nominal design resistance R appearing in the conventional design formulas.[1] The use of a constant termination results in a response which differs from that of a filter terminated by its image impedance.

Methods for calculating the effects of the termination and of dissipation are described by Shea,[2] and the use of terminations different from the nominal design resistance is discussed by Guillemin.[3] However, because of their generalized nature, these methods require considerable calculation for any specific filter configuration. Giacoletto[4] also discusses the use of nonnominal terminations, but neglects the effect of dissipation.

For the simpler filter configurations it is possible to describe the combined effects of termination and dissipation by means of universal curves. Such curves will be presented here for low-pass, high-pass, and band-pass filters of the following configurations: constant-*k* half and full section, constant-*k* full section terminated with $m = 0.6$ half sections, and constant-*k* full section terminated at one end with an $m = 0.8$ half section.

II. PRESENTATION

The response of a filter is most concisely described in terms of its insertion loss. The insertion loss is the loss resulting when the filter is introduced between a generator and a load, i.e., it is the ratio of the voltage across the load when the filter is in the circuit to the voltage across the load when the filter is removed and the gen-

---

* Decimal classification: R143.2×R386. Original manuscript received by the Institute, May 15, 1952; revised manuscript received November 7, 1952.

† Navy Dept., David Taylor Model Basin, Washington 7, D. C.

[1] See, for example, the design formulas of T. E. Shea, "Transmission Networks and Wave Filters," D. Van Nostrand Co., New York, N. Y.; 1929, or F. E. Terman, "Radio Engineers Handbook," McGraw-Hill Book Co., Inc., New York, N. Y.; 1943. The nomenclature used here is essentially that of Shea.

[2] Shea, *loc. cit.*

[3] E. A. Guillemin, "Communication Networks," John Wiley and Sons, New York, N. Y., vol. 2; 1935.

[4] L. J. Giacoletto, "Optimum resistive terminations for single-section constant-*K* ladder-type filters," *RCA Rev.*, vol. 8, pp. 460–479; September 1947.

erator is connected directly to the load. The insertion loss differs from the attenuation in that it includes the effect of the terminations.

The insertion loss of a filter with a given configuration of elements can be described in terms of four independent dimensionless parameters. These parameters can be defined in such a way that one curve applies alike to low-pass, high-pass, and band-pass filters.

The theoretical basis for these parameters is discussed in the Appendix. At this point the discussion is limited to their definitions.

A dimensionless frequency parameter F is defined as

$$F = f/f_c$$

for a low-pass filter,

$$F = f_c/f$$

for a high-pass filter, and

$$F = \frac{f - f_m}{f_2 - f_1}\left(1 + \frac{f_m}{f}\right)$$

$$\simeq (f - f_m)/\tfrac{1}{2}(f_2 - f_1) \quad \text{if} \quad |f - f_m| \ll f_m$$

for a band-pass filter, where f is the signal frequency, f_c the cutoff frequency, and f_m the midband frequency of a band-pass filter with cutoff frequencies f_1 and f_2. F is less than 1 within the pass band, and greater than 1 outside the pass band.

The dissipation is represented by a dissipation parameter D.

$$D = 1/Q_c$$

for low- and high-pass filters, and

$$D = f_m/\tfrac{1}{2}(f_2 - f_1)Q_m$$

for a band-pass filter, where Q_c and Q_m are the Q values of each filter element at the cutoff and midband frequencies, respectively. It is assumed that all elements of the filter have the same Q.[5]

The input and output terminations R_i and R_o are combined with the nominal design resistance R to form termination ratios T_i and T_o, defined as follows:

$$\left.\begin{aligned} T_i &= R/R_i \\ T_o &= R/R_o \end{aligned}\right\} \text{for a mid-series or "}T\text{" termination,}$$

$$\left.\begin{aligned} T_i &= R_i/R \\ T_o &= R_o/R \end{aligned}\right\} \text{for a mid-shunt or "}\pi\text{" termination.}$$

For a symmetrical filter, the input and output terminations may be exchanged without affecting the insertion loss.

III. Curves of Insertion Loss

In Figs. 1 to 4 curves of insertion loss are presented as a function of the frequency parameter F, for several values of the dissipation parameter D and the termination ratios T_i and T_o. Each curve represents either a low-pass, a high-pass, or a band-pass filter, depending on the definitions used for the parameters.

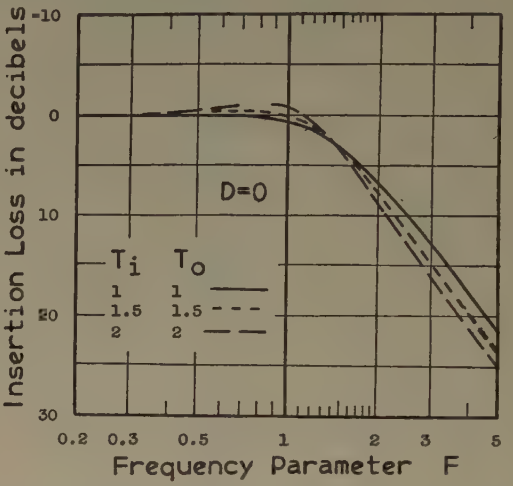


Fig. 1—Insertion loss for a constant-k half section. The dissipation parameter is zero; the effect of dissipation for this half section is discussed in Section IV. Note that the half section has one mid-shunt and one mid-series termination; the appropriate definitions should be used for each termination parameter.

The insert-loss curves were obtained experimentally, using decade capacitors and toroidal inductors connected in the equivalent low-pass configurations. Dissipation was introduced by placing constant resistance in series with series arms, and in parallel with shunt arms. The insertion loss was plotted automatically with an oscillator mechanically coupled to a graphic-level recorder. The procedure may be considered as equivalent to the use of an analog computer, where the scale factors are the dimensionless parameters defined above.

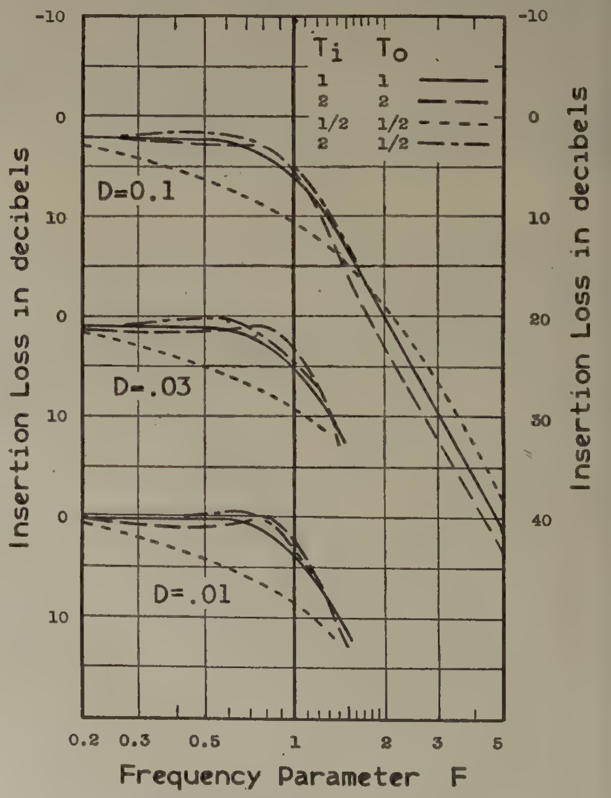


Fig. 2—Insertion loss for a constant-k full section.

---

[5] If an arm contains two elements whose Q's differ, and equal Q_1 and Q_2, the dissipation can be divided equally between both elements, resulting in an equivalent Q for each element of $Q = 2Q_1Q_2/(Q_1+Q_2)$.

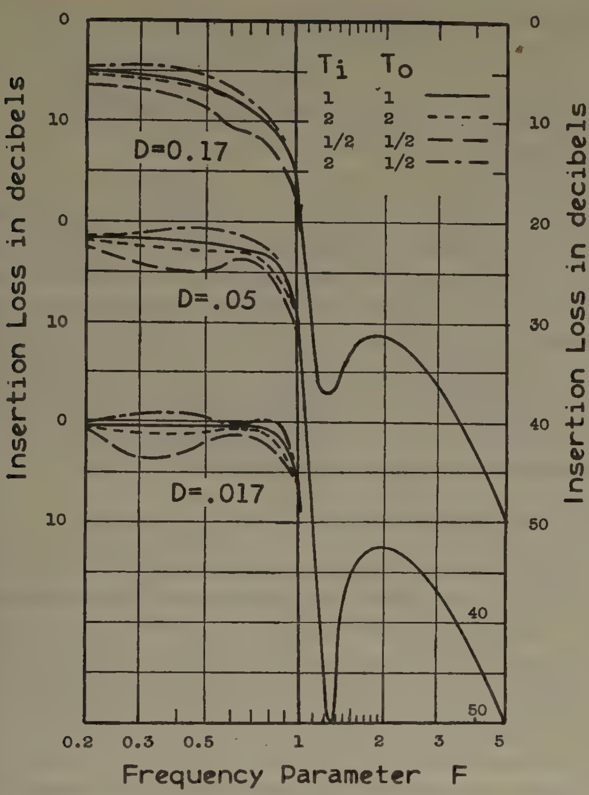


Fig. 3—Insertion loss for a constant-*k* full section terminated at the input side by an $m=0.8$ half section. The insertion loss is the same if the half section is at the output side, provided the termination parameters are interchanged. Note that this configuration has one mid-series and one mid-shunt termination; the appropriate definitions should be used for each termination parameter.

The curves presented here indicate only the magnitude of the insertion loss. The phase angle can be presented in similar fashion, if of interest.

An examination of the insertion-loss curves will indicate the most desirable termination ratios. It is apparent that the use of terminations different from the nominal design resistance R can increase the sharpness of the cutoff. For example, a constant-*k* low- or high-pass filter with elements having a Q_c of only 10, terminated so that the termination ratios equal 2, cuts off as sharply as does a filter with elements having a Q_c of 100 but terminated with the nominal design resistance.

Narrow band-pass filters require elements of proportionally higher Q, however. For example, a filter with a 10-per cent band requires elements with a Q_m of 200 to have the same behavior as a low-pass filter containing elements with a Q_c of only 10.

IV. Additional Dissipation in Terminating Arms

Certain forms of terminating arms may have components with very low Q without adversely affecting the sharpness of cut off.

Consider, for example, a filter with series terminating arms containing dissipative inductances. The equivalent circuit of the arms is shown in Fig. 5, where the series resistances R_1 and R_2 represent the dissipation in the inductances. These resistances may be considered as part of the terminations, i.e., the input termination

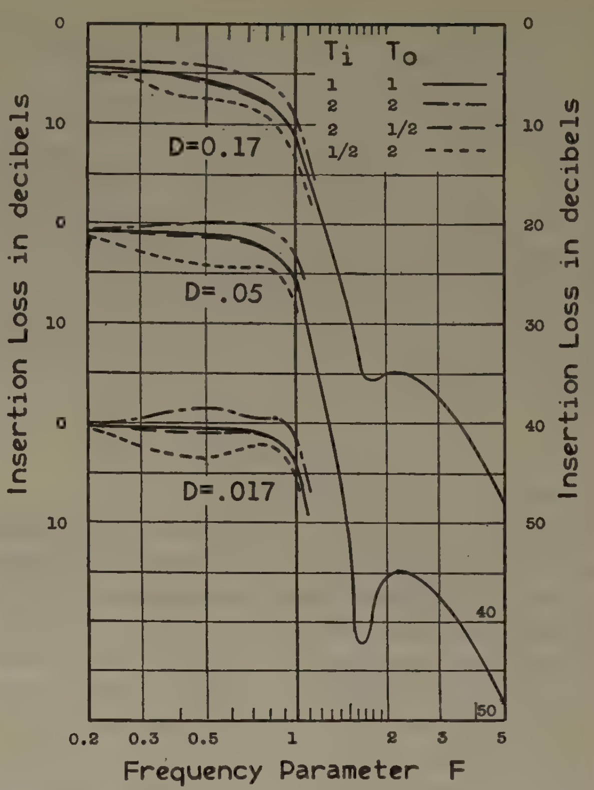


Fig. 4—Insertion loss for a constant-*k* full section terminated on both ends by $m=0.6$ half sections.

may be considered to be (R_i+R_1) and the output termination (R_o+R_2). Accordingly, the insertion loss will be the same as for a filter with dissipationless terminating arms but with larger effective terminations, plus an additional loss equal to

$$20 \log \{1 + [(R_1 + R_2)/(R_i + R_o)]\}.$$

The same considerations apply to shunt terminating arms. In shunt arms, the dissipation may be represented by shunt resistances which reduce the effective value of the terminations.

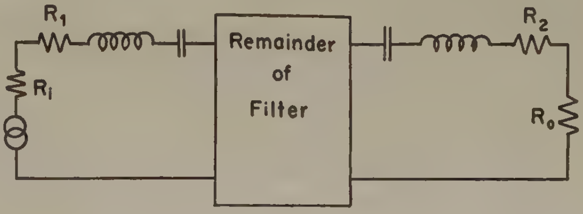


Fig. 5—Transference of dissipation to the terminations.

If the terminating arms are constant-*k* half sections, the effective value of the termination parameters can be shown to equal

$$T_i' = T_i + D_1, \qquad T_o' = T_o + D_2,$$

where D_1 and D_2 are the values of the D parameters for each of the terminating arms. The increased insertion loss equals

$$20 \log [1 + (D_1 + D_2)/(T_i + T_o)].$$

These results apply to both series and shunt terminations, and for low-pass, high-pass, or band-pass configurations.

Accordingly, if a constant increase in insertion loss can be tolerated, the terminating arms of a filter may have quite low Q's without reducing the sharpness of cut off. Q's as low as 6 generally result in no more than 3-db constant insertion loss within the pass band. Only the intermediate sections of the filter need have higher Q's. The constant insertion loss can usually be compensated by additional gain in the amplifiers associated with the filter.

APPENDIX I

The Parameters F, D, T_i, and T_o

In this appendix it will be shown that the insertion loss of constant-k and m-derived ladder filters can be expressed as a function of the parameters F, D, T_i, and T_o, defined in Section II of this paper.

Consider a network with image impedances Z_i and Z_o at the input and output, respectively, terminated in constant resistances R_i and R_o at the input and output, respectively. The insertion loss L of the network consists of the following components, expressed in decibels:[6]

$$L = \alpha + L_1 + L_2 + L_i - L_{12}, \tag{1}$$

where α is the attenuation constant,

L_1 is the reflection loss at the input of the network,
L_2 is the reflection loss at the output of the network,
L_i is the so-called interaction loss, and
L_{12} is the reflection loss between the terminations R_1 and R_0 in the absence of the network.

The attenuation constant of a full "T" or "π" section of a ladder network is,[7] in decibels,

$$\alpha = 20 \log \left| [(1+a)^{1/2} + a^{1/2}]/[(1+a)^{1/2} - a^{1/2}] \right|, \tag{2}$$

where $a = Z_1/4Z_2$, Z_1, and Z_2 being the series and shunt impedances of one full section.

The input reflection loss of a network is, in decibels,[6]

$$L_1 = 20 \log \tfrac{1}{2} \left| t_i + 1/t_i \right|, \tag{3}$$

where $t_i = (Z_i/R_i)^{1/2}$. Z_i has different values for the mid-series and the mid-shunt terminations. For a mid-series-terminated m-derived filter with nominal design resistance R,[8]

$$t_i = (Z_i/R_i)^{1/2} = [T_i(1+a)^{1/2}/(1+a-m^2a)]^{1/2}, \tag{4}$$

where T_i is the termination parameter defined in Section II for the mid-series termination as $T_i = R/R_i$. The output reflection loss L_2 is given by expressions similar to (3) and (4) with T_i replaced by T_o.

The interaction loss is[6]

$$L_i = 20 \log \left| 1 - (t_i - 1/t_i)(t_0 - 1/t_0)e^{-2\theta} \right. \\ \left. /(t_i + 1/t_i)(t_o + 1/t_o) \right|, \tag{5}$$

where θ is the complex propagation constant given by the expression within the brackets of (2).

For a mid-shunt termination, T_i is defined in Section II as the reciprocal of T_i for the mid-series termination. Also, the mid-shunt image impedance $Z_i' = R^2/Z_i$.[9] Accordingly, t_i for a mid-shunt termination is the reciprocal of t_i for a mid-series termination. Since, in the expressions for the losses L_1, L_2, and L_i, the quantities t_i and t_o always occur in reciprocal pairs such as $(t_i \pm 1/t_i)$, it is clear that these losses have the same expressions for both mid-shunt and mid-series terminations.

The reflection loss L_{12} is given by

$$L_{12} = 20 \log \tfrac{1}{2} \left| (T_o/T_i)^{1/2} - (T_i/T_o)^{1/2} \right|. \tag{6}$$

Accordingly, all the components of the insertion loss of an m-derived filter can be expressed as functions of the termination parameters T_i and T_o and the ratio $a = Z_1/4Z_2$. It remains to be shown that $(Z_1/4Z_2)$ can be expressed as a function of the frequency parameter F and the dissipation parameter D defined in Section II.

Consider the band-pass constant-k full section, with full series components L_1 and C_1 and shunt components L_2 and C_2. Represent the dissipation of the two series components by a resistance R_s and that of the two shunt components by a conductance G. Then,

$$Z_1/4Z_2 = (R_s + j\omega L_1 + 1/j\omega C_1)(G + j\omega C_2 + 1/j\omega L_2). \tag{7}$$

Using the design formulas of a band-pass filter,

$$\begin{cases} \omega_0^2 = 1/L_1C_1 = 1/L_2C_2 \\ (\omega_2 - \omega_1)^2 = 4/L_1C_2, \end{cases}$$

and assuming the Q's of all the elements to be equal, i.e.,

$$Q = \omega L_1/\tfrac{1}{2}R_s = 1/\tfrac{1}{2}R_s\omega C_1 = \omega C_2/\tfrac{1}{2}G = 1/\tfrac{1}{2}G\omega L_2,$$

then

$$\begin{aligned} Z_1/4Z_2 &= -\left[\frac{(\omega - \omega_0)}{(\omega_2 - \omega_1)} \left(1 + \frac{\omega_0}{\omega}\right) - j\frac{2\omega_0}{Q_0(\omega_2 - \omega_1)} \right]^2 \\ &= -(F - jD)^2, \end{aligned} \tag{8}$$

where F and D have the definitions given in Section II.

A similar result can be obtained for the constant-k low-pass and high-pass sections.

Also, for an m-derived section,[10]

$$(Z_1/4Z_2)_m = m^2a/(1 + a - m^2a), \tag{9}$$

where $a = Z_i/4Z_2$ for the constant-k section and is given by (8).

Accordingly, for constant-k and m-derived sections, the insertion loss can be expressed in terms of the parameters F, D, T_i and T_o.

---

[6] Shea, *loc. cit.*, eq. (59), p. 119.
[7] *Ibid.*, eq. (64), p. 197.
[8] *Ibid.*, eq. (88), p. 251.
[9] *Ibid.*, eq. (91), p. 251.
[10] *Ibid.*, eq. (73), p. 247.

The Field Radiated by a Ring Quasi-Array of an Infinite Number of Tangential or Radial Dipoles*

H. LOTTRUP KNUDSEN†

Summary—**A homogeneous ring array of axial dipoles will radiate a vertically polarized field that concentrates to an increasing degree around the horizontal plane with increasing increment of the current phase per revolution. There is reason to believe that by using a corresponding antenna system with tangential or radial dipoles, a field may be obtained that has a similar useful structure as the above-mentioned ring array, but which in contrast to the latter is essentially horizontally polarized. In this paper a systematic investigation has been made of the field from such an antenna system with tangential or radial dipoles. Recently it was stated in the literature that it is impossible to treat the general case where the increase of the current phase per revolution is arbitrarily large by using ordinary functions. The results obtained in this paper disprove this statement.**

A similar investigation has been made of the field from the antenna system with tangential dipoles described above in the case where the current distribution on this system is a standing wave instead of a progressing wave.

When the increment of the current phase per revolution converges towards infinity, the gain of the antenna systems treated here converges towards infinity, too, i.e. supergain occurs. Based on the theory of supergain an approximate expression has been derived for the minimum value of the radius of the antenna system, which it is possible to use in practice.

INTRODUCTION

AS WAS SHOWN by Chireix,[1] an azimuthally omnidirectional antenna system with a field that is concentrated around the horizontal plane and with vertical polarization may be obtained by placing a number of vertical dipoles equidistantly along a circle in the horizontal plane (see Fig. 1(d)) and by feeding these dipoles with currents having the same numerical value but a phase increasing uniformly along the circle. An antenna system of this type will be called a homogeneous ring array of axial dipoles. In order that this ring array may be completely omnidirectional in the horizontal plane the number of dipoles must be infinitely large (see Fig. 1(a)). The current phase increases a whole number, H, times 2π during one revolution in the positive direction.

Denoting the radius of the circle by a, the angle between the normal to the plane of the circle and the direction from the ring array to the field point by θ, and the azimuth of this point by ϕ, we find—according to Chireix—the following expression for the array characteristic $G(\theta, \phi)$ of a homogeneous ring array with infinitely many elements:

$$G = K_1 e^{iH\phi} J_H(ka \sin \theta).\text{[2]} \qquad (1)$$

In this expression K_1 is a constant depending on the choice of the reference antenna, whereas k denotes the intrinsic transmission coefficient, $k = 2\pi/\lambda$, of free space, where λ is the wavelength.

If the radius a of the circle is so small that $ka \ll 1$, we find from (1) the following approximate expression for $|G|$

$$|G| \cong K_2 \sin^H \theta, \qquad (2)$$

where K_2 is a constant. This expression shows that the field, which is polarized in the θ-direction for any value of the increment, $H2\pi$, of the current phase, concentrates more and more around the horizontal plane with increasing values of $|H|$. Chireix proposes that this property of the homogeneous ring array might be used for obtaining a fading-reducing antenna system.

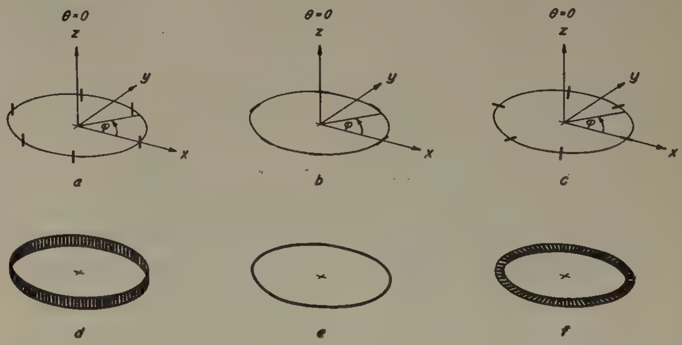


Fig. 1—(a) Ring array of a finite number of axial dipoles. (b) Ring quasi-array of a finite number of tangential dipoles. (c) Ring quasi-array of a finite number of radial dipoles. (d) Ring array of an infinite number of axial dipoles. (e) Ring quasi-array of a infinite number of tangential dipoles. (f) Ring quasi-array of an infinite number of radial dipoles.

Of late years FM and television have aroused interest in horizontally polarized fields. It is an obvious thing, therefore, in analogy with Chireix's investigation of a homogeneous ring array of axial dipoles, to carry out an investigation of the field from corresponding ring-shaped antenna systems with tangential or radial dipoles. The elements in these antenna systems are identical, but not identically oriented. In what follows we shall denote an antenna system composed of identical but not necessarily identically oriented elements as a quasi-array. In this paper we set the problem of calculating the field from a homogeneous ring quasi-array of an infinite number of tangential or radial dipoles. The adjective "homogeneous" denotes here, as in the case of the ring array, that the antennas are placed equidistantly, and that they carry currents with the same numerical value but with a phase that increases uniformly along the circle. The increment of the phase during one revolution is denoted by $H2\pi$. With the notation used in Fig. 1 a ring quasi-array of tangential or radial dipoles may be expected to radiate a field that is polarized essentially in the ϕ-direction, and which concentrates to an increasing degree around the horizontal plane with increasing $|H|$.

---

* Decimal classification: R120. Original manuscript received by the Institute, November 11, 1951; revised manuscript received December 17, 1952.

† The Microwave Laboratory, The Royal Technical University of Denmark, Copenhagen, Denmark.

[1] H. Chireix, "Antennes a rayonnement zénithal réduit," *L'Onde Élec.*, vol. 15, pp. 440–456; 1936.

[2] As time factor is used $e^{-i\omega t}$.

Figs. 1(b) and (c) show a ring quasi-array of respectively tangential and radial dipoles. In Figs. 1(e) and (f) are shown the corresponding antenna systems with an infinite number of elements. It is observed that a ring quasi-array of tangential dipoles then degenerates into a wire bent in a circle, i.e. a circular frame aerial.

Carter[3] has carried through a calculation of the field from an array of a finite number of axial dipoles and a ring quasi-array of a finite number of tangential or radial dipoles placed concentrically around a conducting cylinder and with $H=0$ or $H=1$. In the case where the radius of the conducting cylinder is equal to zero, and where the number of dipoles converges towards infinity, the antenna systems treated by Carter constitute special cases of the systems investigated in this paper.

The field from an arbitrarily large, circular frame aerial with constant current (i.e., $H=0$) has previously been investigated by Foster[4] and Moullin.[5] This field calculation is included in the present investigation as a special case. The general case of a circular frame aerial with a standing or a progressing current wave has been tackled by Sherman.[6] However, Sherman arrives at the conclusion that a calculation of the field in an arbitrary direction cannot be carried out. This statement is contradicted by the results obtained in this paper. The present paper deals particularly with quasi-arrays with progressing current waves. It seems as if a satisfactory treatment of a circular frame aerial with a standing current wave has not been given in the literature; this case is therefore also treated in the present paper.

A HOMOGENEOUS RING QUASI-ARRAY OF TANGENTIAL DIPOLES

Calculation of the Field

In this section we shall calculate the field from a homogeneous ring quasi-array of an infinite number of dipoles placed along a circle with radius a so that the dipoles are tangent to this circle, as shown in Fig. 1(e). We first formulate the problem of the corresponding ring quasi-array with a finite number, s, of elements, each one having the length L, see Fig. 1(b). As sketched in this figure, we introduce a spherical co-ordinate system (r, θ, ϕ) and a rectangular co-ordinate system (x, y, z) corresponding to the first system in the usual way. In the rectangular co-ordinate system the j'th dipole has the co-ordinate $(a \cos u_j, a \sin u_j, 0)$, where

$$u_j = \frac{2\pi j}{s}, \qquad j = 1, 2, \cdots, s. \tag{3}$$

The current I_j in the j'th dipole is given by

$$I_j = Ie^{iHu_j}, \tag{4}$$

where I is a complex constant and H an integral number.

In calculating the radiated field we use the method of radiation vectors described by Schelkunoff.[7] Denoting by ζ the intrinsic impedance of free space, by $\bar{r}$ the vector pointing from the center of the antenna system to the field point, and setting $|\bar{r}| = r$, we define a constant T by

$$T = \frac{iksL\zeta I}{4\pi r} e^{ikr}. \tag{5}$$

By using the radiation vector $\bar{F}(\theta, \phi)$ we may then express the electric and the magnetic field strength in the radiated field as follows

$$\bar{E} = T\bar{F}, \qquad \bar{H} = \zeta^{-1}\frac{\bar{r}}{r} \times \bar{E}, \tag{6, 7}$$

where

$$\begin{aligned} F_r &= 0, \\ F_\theta &= F_x \cos\theta\cos\phi + F_y \cos\theta\sin\phi - F_z \sin\theta, \\ F_\phi &= -F_x \sin\phi + F_y \cos\phi. \end{aligned} \tag{8}$$

The x-, y-, and z-components of the radiation vector $\bar{F}$ are given by

$$F_x = -S\sin u_j, \quad F_y = S\cos u_j, \quad F_z = 0, \tag{9}$$

where

$$S = \frac{1}{s}\sum_{j=1}^{s} e^{i[Hu_j - z\cos(\phi - u_j)]}, \tag{10}$$

$$z = ka \sin\theta. \tag{11}$$

The parameter z must not be mistaken for the co-ordinate z, which does not occur in the calculation. The electric field strength is essentially expressed through the vector $\bar{F}$. For this reason $\bar{F}$ shall be called the normalized electric field strength.

In the present case where the number of elements is finite, the following limiting process must be performed in the above expression

$$\begin{aligned} s &\to \infty, \\ u_j &\to u, \\ \Delta u_j &= \frac{2\pi}{s} \to du. \end{aligned} \tag{12}$$

---

[3] P. S. Carter, "Antenna arrays around cylinders," PROC. I.R.E., vol. 31, pp. 671–693; 1943.

[4] D. Foster, "Loop antennas with uniform current," paper presented before a joint meeting of the I.R.E. and U.R.S.I.; April, 1937.

[5] E. B. Moullin, "Radiation from large circular loops," *Jour. IEE* (London), pt. III, vol. 93, pp. 345–351; 1946.

[6] J. B. Sherman, "Circular loop antennas at ultrahigh frequencies," PROC. I.R.E., vol. 32, pp. 534–537; 1944.

[7] S. A. Schelkunoff, "Electromagnetic Waves," D. van Nostrand Company, Inc., New York, N. Y., pp. 330–336; 1943.

Setting

$$h = \frac{1}{2\pi} e^{i[Hu - z\cos(\phi - u)]}, \tag{13}$$

we obtain

$$F_x = -\int_0^{2\pi} h \sin u du, \quad F_y = \int_0^{2\pi} h \cos u du, \tag{14}$$
$$F_z = 0.$$

By a further transformation and application of Sommerfeld's integral formula for a Bessel function[8] we find, as shown in the appendix,

$$F_x = \left[\frac{H}{z} J_H(z) \cos\phi - iJ_H'(z) \sin\phi\right] e^{iH(\phi - \pi/2)},$$
$$F_y = \left[iJ_H'(z) \cos\phi + \frac{H}{z} J_H(z) \sin\phi\right] e^{iH(\phi - \pi/2)}, \tag{15}$$
$$F_z = 0.$$

By inserting these expressions in (8) we find the following expressions for the θ- and ϕ-components of the normalized, electric field strength:

$$F_\theta = \frac{H}{z} J_H(z) \cos\theta e^{iH(\phi - \pi/2)},$$
$$F_\phi = iJ_H'(z) e^{iH(\phi - \pi/2)}. \tag{16}$$

Discussion of the Result

The homogeneous ring quasi-array in question is seen to be azimuthally omnidirectional. However, the phase of the field depends on ϕ in the way expressed through the factor $e^{iH(\phi-\pi/2)}$. The equiphase lines in the horizontal plane thus constitute a system of H Archimedes's spirals as is the case of the field from a ring array. The field is said to be one that is spiral-phase. As has been detailed by Sandeman,[9] spiral-phase fields are utilized in navigation for the purpose of direction-finding. Granquist[10] has used a spiral-phase field and the corresponding field obtained by reversing the current phases to a simple determination of both distance and direction.

The component F_θ is 90° out of phase with F_ϕ. Therefore, the field will generally be elliptically polarized. The polarization will only in special cases degenerate into circular or linear polarization.

For $H \neq \pm 1$ and for $\theta = 0$ or π we find $F_\theta = F_\phi = 0$. The radiation in the direction of the axis is different from zero only for $H = \pm 1$. The corresponding result for a standing current wave was derived already by Sherman[6] through a more direct argumentation.

We shall first investigate the appearance of the components of the normalized, electric field strength for small values of the radius of the circle. Assuming that $(a/\lambda) \ll (1/2\pi)$ we obtain the following results:
$H = 0$.

$$F_\theta = 0, \quad F_\phi \cong -i\alpha_0 \sin\theta. \tag{17}$$

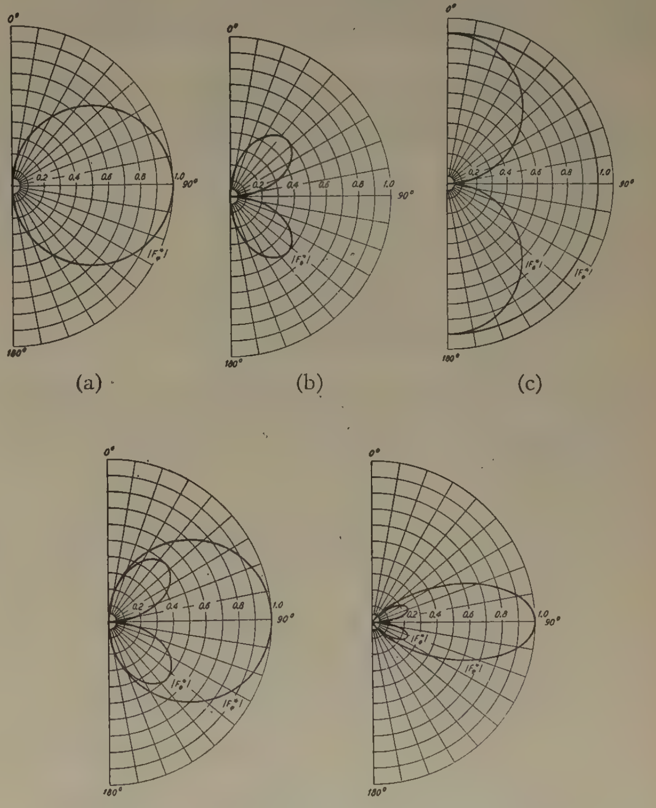
$H \geqq 1$.

$$F_\theta \cong \alpha_H \cos\theta \sin^{H-1}\theta e^{iH(\phi - \pi/2)},$$
$$F_\phi \cong i\alpha_H \sin^{H-1}\theta e^{iH(\phi - \pi/2)}. \tag{18}$$

In these expressions α_H denotes constants. In Figs. 2(a) and (c–e), $1/\alpha_H$ times the θ- and ϕ-components of the normalized, electric field strength $\overline{F}$ are plotted as functions of θ. When $H \geqq 2$, the field is seen to have the same character for any value of H. When H increases, the component F_ϕ will concentrate to an increasing degree around the plane of the circle, whereas F_θ will decrease towards zero. In the case of $H \geqq 1$ the maximum value of F_θ occurs for $\theta = \theta'$ and $\theta = \theta'' = \pi - \theta'$, where

$$\theta' = \text{arctg}\sqrt{H - 1}. \tag{19}$$

The angle $\theta' = \pi - \theta''$ is plotted as a function of H through the firm line curve in Fig. 3. The quotient κ, between the maximum values of F_θ and F_ϕ, is expressed



(a) (b) (c)

(d) (e)

Fig. 2—Vertical pattern of α_H^{-1} multiplied by the normalized, electric field strength $\overline{F}(\theta, \phi)$ for a small, homogeneous ring quasi-array of an infinite number of tangential or radial dipoles. (a) Tang. dipoles, $H=0$. (b) Rad. dipoles, $H=0$. (c) Tang. and rad. dipoles, $H=1$. (d) Tang. and rad. dipoles, $H=2$. (e) Tang. and rad. dipoles, $H=7$.

---

[8] E. Jahnke and F. Emde, "Funktionentafeen," Dritte Auflage, B. G. Qeukner Verlag, Leipzig and Berlin, p. 149; 1938.

[9] E. K. Sandeman, "Spiral-phase fields," *Wireless Eng.*, vol. 26, pp. 96–105; 1949.

[10] C. E. Granqvist, "Radiofyr för avstånd och riktning," paper presented before Radiovetenskapliga Konferensen, Stockholm, Sweden; 1949.

through

$$\kappa = \cos\theta' \sin^{H-1}\theta'. \tag{20}$$

The quotient κ is plotted as a function of H through the firm line curve in Fig. 4. When H converges towards infinity, the angle θ' will converge towards $\pi/2$, i.e., the two loops in F_θ will approach unlimitedly the horizontal plane. At the same time the quotient κ will converge towards zero, i.e., the field will in the limit become horizontally polarized. However, as Fig. 4 shows, the horizontal component of the field becomes vanishingly small first when H becomes very large. As will be discussed in a following section, large fundamental difficulties will arise when the increment of the current phase, $H2\pi$, for an antenna with fixed dimensions increases beyond a certain limit.

For very large values of H the following approximate expressions for the angle θ' and the quotient κ may be derived:

$$\theta' \cong \frac{\pi}{2} - \frac{1}{\sqrt{H-1}}, \tag{21}$$

$$\kappa \cong \frac{1}{\sqrt{e(H-1)}} \cong \frac{0.6065}{\sqrt{H-1}}, \tag{22}$$

where e denotes the basis of the natural logarithms. These approximate expressions are plotted as the dotted curves in Figs. 3 and 4.

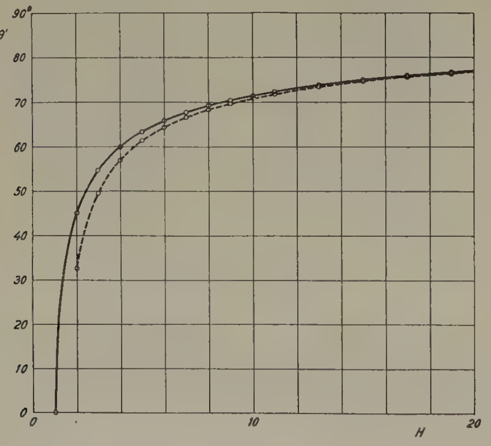


Fig. 3—The angle θ' or $(\pi/2)-\theta''$, θ' and θ'' being the pole distances for the directions in which maximum occurs for the θ-component of the electric field strength of the field from a small, homogeneous ring quasi-array of an infinite number of tangential or radial dipoles. The firm line curve corresponds to the exact expression (19), whereas the dotted curve corresponds to the approximate expression (21).

We now return to the general case where not necessarily $a/\lambda \ll 1$, as was assumed in the preceding paragraph. First we consider the case where the current in the frame aerial has not only a constant numerical value but also a constant phase. For a frame aerial being fed at a single point of the circumference, this current distribution constitutes a good approximation to the actual distribution, when the perimeter of the frame is small as compared with the wavelength. This has been utilized in the elementary theory of frame aerials.[11] In frame aerials, the perimeter of which is large as compared with the wavelength, the current can only be constant if special arrangements are made for feeding the antenna. Foster[12] has proposed to feed the antenna sectionally; this idea has been carried out by Alford and Kandoian.[13,14] Moullin[5] has proposed to realize a constant current distribution by using a large number of tangential dipoles. In the case being considered here, $H=0$, the field has only a ϕ-component as an elementary consideration also shows. For $H=0$ the expressions obtained above for the field components were previously derived and discussed by Foster[4] and by Moullin.[5] For the sake of completeness $|F_\phi|$ is plotted as a function of θ and for various values of a/λ in Figs. 5(a–c).

For $H=1$ the numerical values of the components of the normalized, electric field strength are plotted in Figs. 5(d–f) for the same values of a/λ as in the case $H=0$. For $\theta=0$ or π we find

$$F_\theta = \mp\frac{i}{2}e^{i\phi}, \qquad F_\phi = \frac{1}{2}e^{i\phi}. \tag{23}$$

The field is seen to be circularly polarized in the direction of the axis. For $a/\lambda = 0.1$ to 0.2, i.e., when the perimeter of the circle is about one wavelength, the current distribution on the antenna has the same character as the current distribution on a single turn of the helical antenna developed by Kraus.[15] The fields from the two

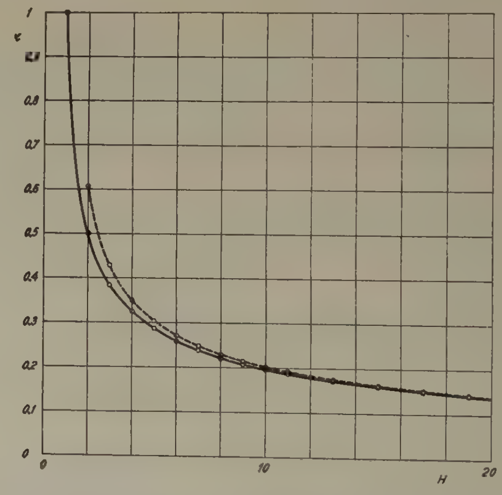


Fig. 4—The quotient κ of the maximum values of F_θ and F_ϕ for the field radiated by a small, homogeneous ring quasi-array of tangential or radial dipoles. The firm line curve corresponds to the exact expression (20), whereas the dotted curve corresponds to the approximate expression (22).

---

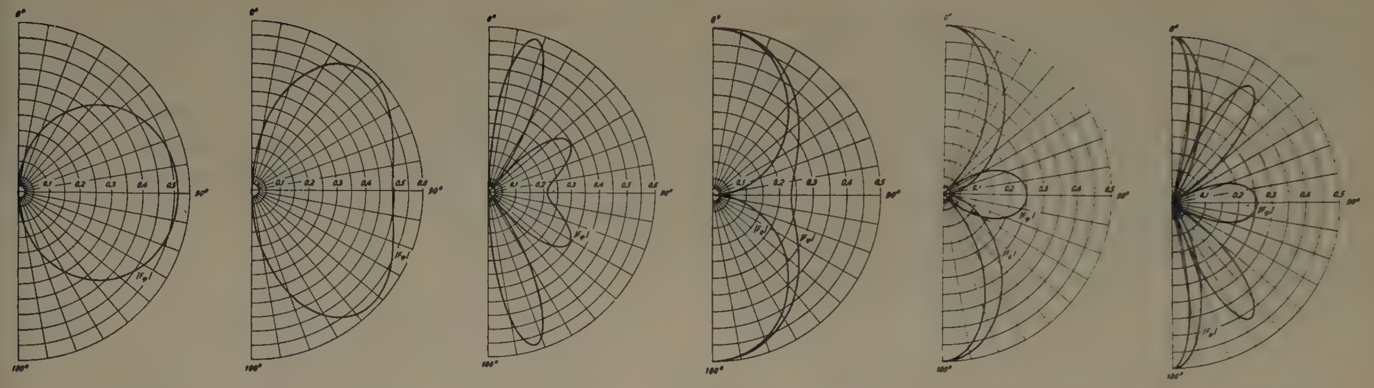
[11] J. H. Dellinger, "Principles of transmission and reception with antennas and coil aerials," U. S. Bur. Stand., vol. 15, pp. 435–495; December, 1919.

[12] D. Foster, "Loop antennas with uniform current," Proc. I.R.E., vol. 32, pp. 603–607; 1944.

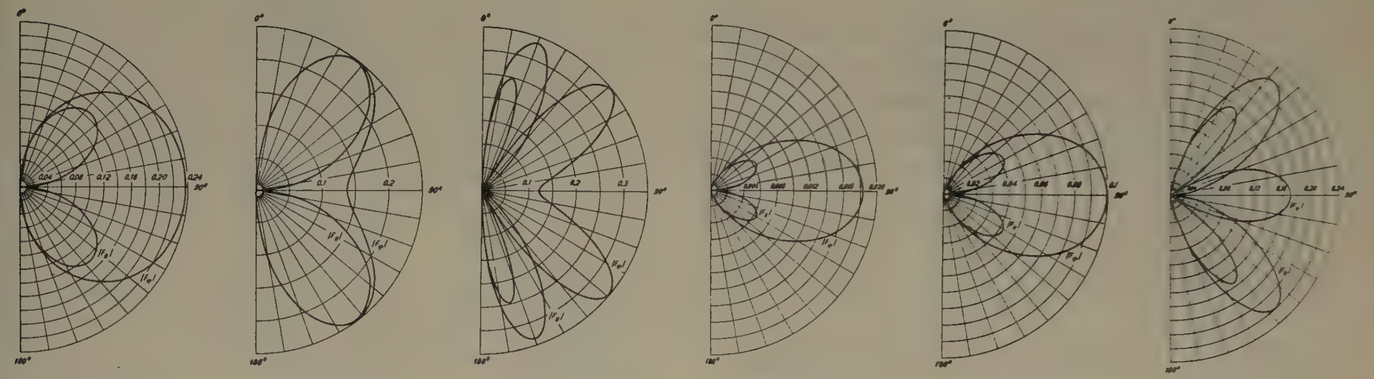
[13] A. Alford and A. G. Kandoian, "Ultra-high-frequency loop antennas," *Trans. AIEE*, vol. 59, pp. 843–848; 1940.

[14] A. G. Kandoian, "Three new antenna types and their applications," Proc. I.R.E., vol. 34, pp. 70 W-75W; 1946.

[15] J. D. Kraus, "The helical antenna." Proc. I.R.E., vol. 37, pp. 263–272; 1949.



(a) $H=0$ $a/\lambda=0.2$ (b) $H=0$ $a/\lambda=0.4.$ (c) $H=0,$ $a/\lambda=1.0.$ (d) $H=\pm 1,$ $a/\lambda=0.2.$ (e) $H=\pm 1,$ $a/\lambda=0.4.$ (f) $H=\pm 1,$ $a/\lambda=1.0.$



(g) $H=\pm 2,$ $a/\lambda=0.2.$ (h) $H=\pm 2,$ $a/\lambda=0.4.$ (i) $H=\pm 2,$ $a/\lambda=1.0.$ (j) $H=\pm 4,$ $a/\lambda=0.2.$ (k) $H=\pm 4,$ $a/\lambda=0.4.$ (l) $H=\pm 4,$ $a/\lambda=1.0.$

Fig. 5—(Right) Vertical pattern of the θ- and ϕ-components of the normalized, electric field strength $\overline{F}(\theta, \phi)$ of the field from a homogeneous, ring quasi-array of an infinite number of tangential dipoles.

antennas are also similar, and the calculation of the fields may proceed along the same lines.[16,17]

For $H=-1$, similar statements regarding the field apply as in the case of $H=1$.

The numerical values of the components F_θ and F_ϕ are plotted in Figs. 5(g–i) for $H=\pm 2$ and in Figs. 5(j–l) for $H=\pm 4$. These figures show that the field concentrates, to an increasing degree, around the horizontal plane with increasing $|H|$, but that the structure of the field changes considerably when the radius increases beyond a certain value dependent on $|H|$, extra loops then beginning to appear in the radiation pattern. If it is desired to utilize the properties of the field that are characteristic of small values of the radius, and which were discussed in detail above, it is therefore necessary to choose a radius that does not exceed the just-mentioned value dependent on $|H|$. On the other hand, other considerations set a lower limit for the radius as will be discussed in a following section.

RING QUASI-ARRAY OF TANGENTIAL DIPOLES SINE-SHAPED CURRENT DISTRIBUTION

Calculation of the Field

We desire to calculate the field from a ring quasi-array of an infinite number of tangential dipoles, i.e., a circular frame aerial, as shown in Fig. 1(e), and with a sine-shaped current distribution. We start from a corresponding ring quasi-array of a finite number of elements (see Fig. 1(b)) calling the number of the elements s and their length L. The position of the j'th dipole being given by the angle, u_j, defined in (3), the current, I_j, in the j'th dipole is in the present case expressed through

$$I_j = I \cos Hu_j, \tag{24}$$

where I is a complex constant and H an integral number.

The standing current wave given in (24) may be decomposed into two current waves progressing in opposite directions

$$I_j = \tfrac{1}{2}(e^{iHu_j}+e^{-iHu_j}). \tag{25}$$

---

[16] H. L. Knudsen, "The field from a circular and a square helical beam antenna." Trans. Danish Acad. Tech. Sci. (Copenhagen, Denmark) 1950, No. 8, 55 pp.

[17] H. L. Knudsen, "Radiation field of a square, helical beam antenna," *Jour. Appl. Phys.*, vol. 23, pp. 483–491; 1952.

The field from the sine-shaped current distribution considered here may now be calculated as $\frac{1}{2}$ times the field calculated in the last section for a progressing current wave plus $\frac{1}{2}$ times this field with H replaced by $-H$.

With the factor T expressed by (5) the electric field strength is given by the normalized field strength $\overline{F}$. From the expressions obtained earlier for the components F_θ and F_ϕ for a homogeneous ring quasi-array of an infinite number of tangential dipoles, we find for the sine-shaped current distribution in question

$$\begin{aligned} F_\theta &= -(-i)^{H+1}\frac{H}{z}J_H(z)\cos\theta\sin H\phi, \\ F_\phi &= -(-i)^{H+1}J_H'(z)\cos H\phi. \end{aligned} \qquad (26)$$

Discussion of the Result

The θ- and ϕ- components of the normalized, electric field strength are seen to be in phase; the radiated field is therefore linearly polarized. Denoting by α the angle which the electric field vector in a point of the far zone makes with a circle of latitude through this point, we find

$$\alpha = \operatorname{arctg}\frac{F_\theta}{F_\phi} = \operatorname{arctg}\left[\frac{\frac{H}{z}J_H(z)}{J_H'(z)}\cos\theta \operatorname{tg} H\phi\right]. \qquad (27)$$

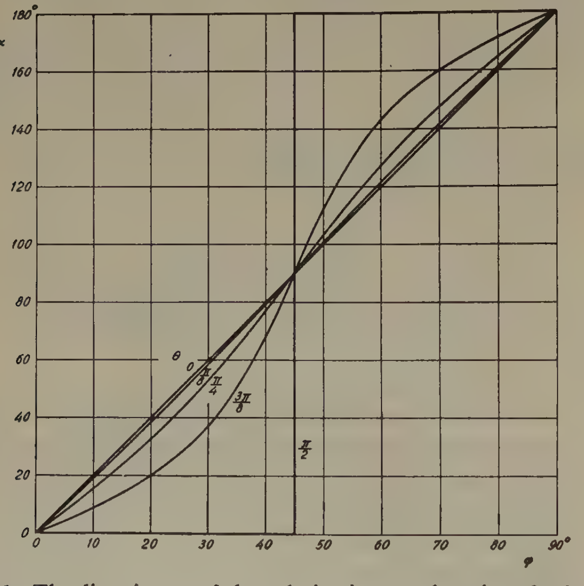


Fig. 6—The direction, α, of the polarization as a function of azimuth ϕ for various values of the pole distance θ for a ring quasi-array with a sine-shaped current distribution, of an infinite number of tangential dipoles, characterized by $H=2$ and $a/\lambda=0.2$. The parts of the curves falling outside those shown here may be generated from these by a parallel translation in $\pi/2$ in the direction of the ϕ-axis and $n\pi$ in the direction of the α-axis (n an integral number).

For $H=0$ the field is horizontally polarized in any direction. During one revolution along a circle of latitude $\theta=$constant, α will increase by $H2\pi$. In Fig. 6 the angle α is plotted as a function of ϕ for $a/\lambda=0.2$, $H=2$, and $\theta=0$, $\pi/8$, $\pi/4$, $3\pi/8$, and $\pi/2$.

The functions $|F_\theta|$ and $|F_\phi|$ occurring here are obtained from the corresponding functions for the field produced by a progressing current wave with the same value of H through multiplication, respectively, by $|\sin H_\phi|$ and by $|\cos H_\phi|$. For $H=\pm 2$ these functions are plotted in Fig. 7. By using these curves or similar curves for other values of H and the curves in Fig. 5 showing $|F_\theta|$ and $|F_\phi|$ for a circular frame aerial with a progressing current wave, one may easily form a mental picture or make a numerical calculation of the field from a circular frame aerial with a sine-shaped current distribution.

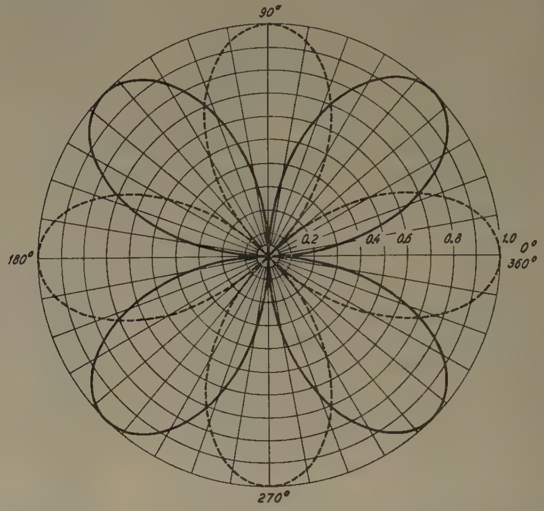


Fig. 7—The functions $|\sin H\phi|$ (firm line curve) and $|\cos H\phi|$ dotted curve) for use in calculating the field from a ring quasi-array, with a sine-shaped current distribution, of an infinite number of tangential dipoles for $H=\pm 2$.

HOMOGENEOUS RING QUASI-ARRAY OF RADIAL DIPOLES

Calculation of the Field

In this section we shall calculate the field from the homogeneous ring quasi-array of an infinite number of radial dipoles shown in Fig. 1(f). We start with the corresponding quasi-array of a finite number of elements shown in Fig. 1(c). The number of elements is denoted by s and their length by L. With the notation used in Fig. 1(c) the j'th dipole will have the co-ordinates ($a \cos u_j$, $a \sin u_j$, 0) where u_j is the angle defined in (3). Current I_j in j'th dipole is supposed to be given by (4).

Using the value of the factor T given in (5) we find, through calculations similar to those in the previous sections, the following expressions for the components of the normalized, electric field strength $\overline{F}$:

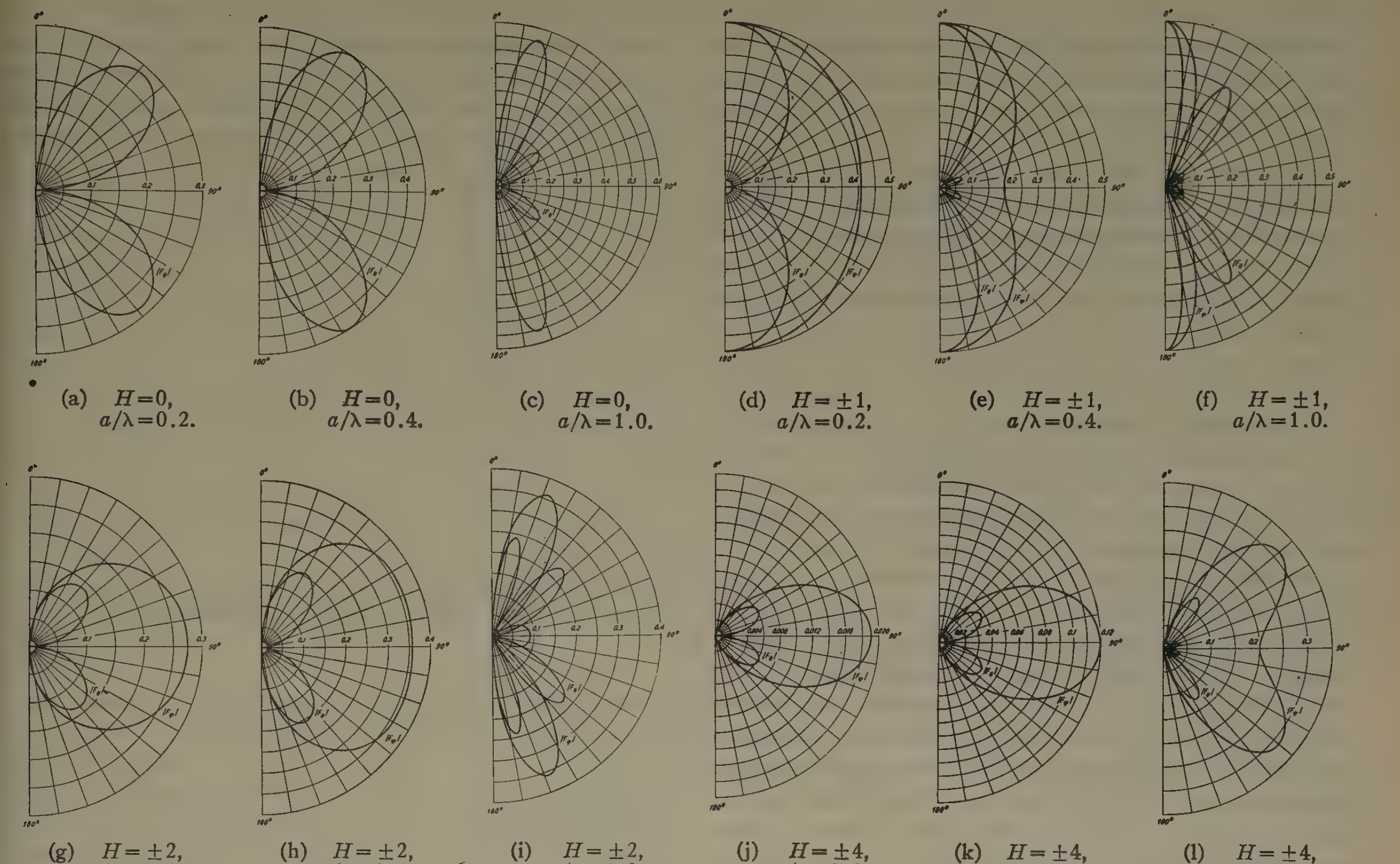
$$F_x = S\cos u_j, \quad F_y = S\sin u_j, \quad F_z = 0, \qquad (28)$$

where S is given by (10). Now introducing the notation $\overline{F}^*$ for the normalized, electric field strength for the corresponding homogeneous ring quasi-array of tangential dipoles we find, by comparing the equations derived above with (9),

$$F_x = F_y^*, \quad F_y = -F_x^*, \quad F_z = 0. \qquad (29)$$

By substituting these expressions in (8) we find the following expressions for the θ- and ϕ-components of the normalized, electric field strength:

$$\begin{aligned} F_\theta &= F_y^*\cos\theta\cos\phi - F_x^*\cos\theta\sin\phi, \\ F_\phi &= -F_y^*\sin\phi - F_x^*\cos\phi. \end{aligned} \qquad (30)$$



(a) $H=0$, $a/\lambda=0.2$. (b) $H=0$, $a/\lambda=0.4$. (c) $H=0$, $a/\lambda=1.0$. (d) $H=\pm1$, $a/\lambda=0.2$. (e) $H=\pm1$, $a/\lambda=0.4$. (f) $H=\pm1$, $a/\lambda=1.0$.

(g) $H=\pm2$, $a/\lambda=0.2$. (h) $H=\pm2$, $a/\lambda=0.4$. (i) $H=\pm2$, $a/\lambda=1.0$. (j) $H=\pm4$, $a/\lambda=0.2$. (k) $H=\pm4$, $a/\lambda=0.4$. (l) $H=\pm4$, $a/\lambda=1.0$.

Fig. 8—Vertical pattern of the θ- and ϕ-components of the normalized, electric field strength $\overline{F}(\theta, \phi)$ of the field from a homogeneous ring quasi-array of an infinite number of radial dipoles.

By comparing these formulas with (8) and using (16), we find the following expressions for the θ- and ϕ-components of the normalized, electric field strength $\overline{F}$:

$$F_\theta = F_\phi^* \cos\theta = iJ_H'(z)\cos\theta e^{iH(\phi-\pi/2)},$$

$$F_\phi = -F_\theta^* \frac{1}{\cos\theta} = -\frac{H}{z}J_H(z)e^{iH(\phi-\pi/2)}. \tag{31}$$

Discussion of the Result

The expressions derived for the field components show that the field is a spiral-phase field, the phase increasing $H2\pi$ during one revolution as indicated by the factor $e^{iH[\phi-(\pi/2)]}$. The field will generally be elliptically polarized. As was the case for a ring quasi-array of tangential dipoles, the field in the direction of the axis from the quasi-array in question will be different from zero only in the case of $H=\pm1$.

We shall first consider the special case where the radius of the circle is so small that $(a/\lambda)\ll(1/2\pi)$. We may then replace the functions occurring in the expressions for the field components by the first term in their series expansions. Hereby, we obtain the expressions:

$H=0$.

$$F_\theta \cong -i\alpha_0 \cos\theta \sin\theta, \qquad F_\phi = 0. \tag{32}$$

$H\geqq1$.

$$F_\theta \cong i\alpha_H \cos\theta \sin^{H-1}\theta e^{iH(\phi-\pi/2)},$$

$$F_\phi \cong -\alpha_H \sin^{H-1}\theta e^{iH(\phi-\pi/2)}, \tag{33}$$

where α_H denotes the same constants as in (17) and (18). Again denoting by $\overline{F}^*$ the normalized, electric field strength of the field from the corresponding homogeneous ring quasi-array of tangential dipoles, we obtain therefore in the case of $(a/\lambda)\ll(1/2\pi)$ and $H\geqq1$.

$$F_\theta \cong iF_\theta^*, \qquad F_\phi \cong iF_\phi^*. \tag{34}$$

For a small radius and $H\geqq1$ the field radiated from the antenna system in question is therefore—apart from a factor $e^{i(\pi/2)}$—identical with the field from the corresponding ring quasi-array of tangential dipoles. In Figs. 2(b–e) are plotted $1/\alpha_H$ times the components F_θ and F_ϕ for various values of H. For $(a/\lambda)\ll(1/2\pi)$ and $H\geqq1$ the quotient κ between the maximum values of the θ- and the ϕ-components of the electric field strength is approximately given by the same expression (20), and therefore by the same curve (Fig. 4) as in the case of a ring quasi-array of tangential dipoles.

We now proceed to the general case, in which no assumption is made regarding the size of the antenna system. Whereas in the case of $(a/\lambda)\ll(1/2\pi)$ and $|H|\geqq1$, the field from the quasi-array of radial dipoles considered here is approximately identical with the field from the corresponding quasi-array of tangential dipoles, an increasing inconsistency will set in with increasing radius. The numerical values of the components F_θ and F_ϕ of the normalized, electric field strength for the field from a homogeneous ring quasi-array of radial dipoles are plotted in Figs. 8(a–l) for $H=0$, ±1, ±2, and ±4

and for various values of a/λ. In the case of $|H| \geqq 1$ the comments given above to Fig. 5 regarding the field from a homogeneous ring quasi-array of tangential dipoles also apply to the present antenna system with radial dipoles.

For $H=0$ the quasi-array considered here is of the same type as the disk antenna introduced by Böhm.[18] Furthermore, a homogeneous ring quasi-array of radial dipoles with $H=\pm 1$ is similar to a turnstile antenna in which the number of arms is infinite and not four as in the usual type.[19]

SUPERGAIN

As previously mentioned, the array characteristic G of a homogeneous ring array, the radius a of which is small as compared with the wavelength, and the current phase of which increases $H2\pi$ during one revolution, may approximately be expressed through $G=K \sin^H \theta$. With constant dimensions of the antenna and with increasing H the radiation pattern will consequently approach the disk-shape, i.e., the gain in horizontal directions will converge towards infinity for $H \to \infty$. However, this contradicts practical experience, according to which the gain of an antenna with fixed dimensions cannot exceed a certain value depending on these dimensions. During the last decade this paradox has been extensively discussed in the literature under the name of supergain. A bibliography of this subject is given in a paper by the author;[20] its connection with the communication theory is discussed in another paper by the author.[21] The explanation of the said paradox is that it is certainly possible to calculate a current distribution giving an arbitrarily large gain; but if this gain increases beyond the value characteristic of the size of the antenna in question, the Q of the antenna increases so violently that the antenna rapidly becomes inapplicable.

A homogeneous ring array seems to be the simplest example of an antenna having supergain. Other simple examples of supergain antennas are homogeneous ring quasi-arrays of tangential or radial dipoles as shown by (18) and (33). We shall investigate the limitation in the use of these ring quasi-arrays which may be deduced from the theory of supergain. Of the various points of view on supergain contained in the literature we shall base our considerations on Woodward and Lawson's[22] approach to the problem. Woodward and Lawson, whose paper deals with a linear array, utilize the fact that the horizontal pattern of the array characteristic G, as expressed as a function of $t=\sin\phi$, where ϕ is the angular deviation from the direction normal to the group, as shown in Fig. 9, is the Fourier transform of the current distribution I along the array expressed as a function of the co-ordinate y. Consequently, the current distribution $I(y)$ will be equal to the inverse Fourier transform of $G(t)$. This inverse transform being expressed through an integration with respect to t over the interval $-\infty < t < \infty$, not only the values of the array characteristic $G(t)$ corresponding to $-1 < t < 1$, i.e., to real values of the azimuth ϕ, but also the values of $G(t)$ corresponding to $-\infty < t < -1$ and $1 < t < \infty$, will contribute to the current distribution $I(y)$. These last-mentioned intervals of t correspond to the two vertical branches of the integration path C in the complex ϕ-plane shown in Fig. 10, i.e., to complex values of ϕ. Large values of $G(t)$ for values of t outside the interval $-1 < t < 1$ consequently contribute to the current $I(y)$ without leaving any contribution to the radiation field, i.e., the Q of the antenna will be large. Hence it follows that for an antenna array to be applicable in practice,

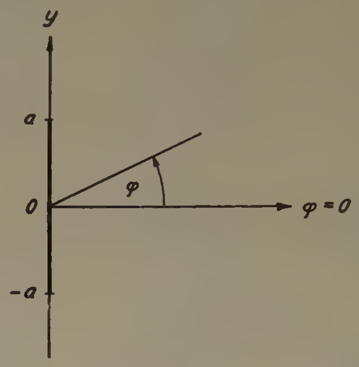


Fig. 9—Co-ordinates used in describing the current distribution and the array characteristic of a linear array with the length 2a.

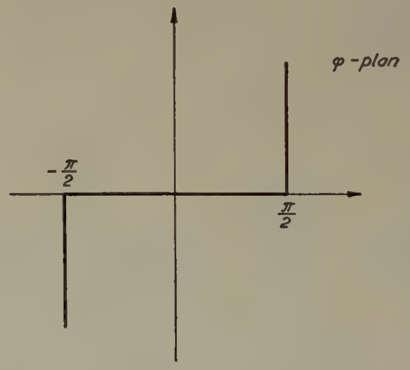


Fig. 10—Path of integration for the contour integral expressing $I(y)$ as a function of the array characteristic $G(t)$.

---

[18] O. Böhm, "Langwellen-Rundfunkantennen mit Underdrückung der Steilstrahlung," *Telefunkenztg.*, vol. 13, pp. 21–26; March, 1932.

[19] G. H. Brown, "Turnstile aerials," *Electronics*, vol. 9, pp. 14–17 and 48; April, 1936.

[20] H. L. Knudsen, "Superforstærkning hos antenner," *Elektroteknisk Tidsskrift* (Oslo, Norway), vol. 64, pp. 213–221; 1951.

[21] H. L. Knudsen, "Shannons tidsopdelingssætning og superforstærkning hos antenner," *Teknisk Tidskrift* (Stockholm, Sweden); vol. 82, pp. 1023–1030; 1952.

[22] P. M. Woodward and J. D. Lawson, "The theoretical precision with which an arbitrary radiation-pattern may be obtained from a source of finite size," *Jour. IEE* (London), Pt. III, vol. 95, pp. 363–369; 1948.

array characteristic $G(t)$ must converge rapidly towards zero when we move outside the interval $-1<t<1$.

For a homogeneous ring quasi-array of tangential dipoles the components of the normalized, electric field strength $\overline{F}$ are expressed by the current distribution $I\,e^{iHu}$ through the transforms (14). The components of the field from a ring quasi-array of radial antennas are expressed by the current distribution through similar transforms. An argument similar to the one applied above may be used here, and also in the present case we arrive at the conclusion that in order to obtain an antenna that is applicable in practice we must demand that the essential part of the radiation from the antenna takes place for real values of the pole distance θ. Defining $t=\sin\theta$ this means for values of t in the interval $0<t<1$. It appears from (15) and (29) that the field components F_x and F_y are linear combinations of the functions $(H/x)J_H(x)$ and $J_H'(x)$ where $x=kat$. The smallest value of ka for which the essential part of either function comes within the interval $0<t<1$ is roughly given by

$$ka_{\min}\cong H \quad \text{or} \quad a_{\min}\cong\frac{H\lambda}{2\pi}\cdot \tag{35}$$

The increment of the current phase per unit length in a homogeneous ring quasi-array with the minimum applicable radius is seen to be equal to the increment per unit length in a conventional, linear end-fire array. As is well known, the increment of the current phase per unit length in an array of this kind is approximately the largest admissible one. Even in case of such a small extra increment of the current phase along the array as π, as proposed by Hansen and Woodyard,[23] inconveniences begin to arise. This was mentioned by these authors themselves and further stressed by Schelkunoff[24] and Reid.[25] It appears from Figs. 5 and 8 that the minimum radii are not large enough to cause the field from quasi-arrays with these radii to differ essentially from the field of a ring quasi-array with a vanishingly small radius.

CONCLUSION

A calculation has been made of the field from a homogeneous ring quasi-array of an infinite number of tangential or radial dipoles, in which the current phase increases $H2\pi$ during one revolution. It is shown that apart from the case $H=\pm1$ the field will, to an increasing degree, concentrate around the horizontal plane with increasing H. At the same time the field will approach more and more horizontal polarization. A corresponding investigation has been made of the field from a ring quasi-array of an infinite number of tangential dipoles in the case where the current distribution along the quasi-array is a standing current wave. A circular frame aerial that is fed at a single point of its circumference, approximates such an antenna system. The field radiated from this quasi-array is linearly polarized.

For $H\rightarrow\infty$ the gain of the antenna systems investigated here converge towards infinity. By applying the theory of supergain an approximate expression has been derived for the minimum radius that the quasi-array may have for a given value of H, without the antenna having a Q too large to be applicable in practice.

The present article is the first of a series of papers dealing with homogeneous ring quasi-arrays.

ACKNOWLEDGMENT

The investigation presented here was carried out at the Microwave Laboratory of the Royal Technical University of Denmark, with a grant from the Research Council of the Technical Sciences in Denmark. I am indebted to the head of the Microwave Laboratory, Professor J. Oskar Nielsen, for the interest with which he has followed this work, and to Mr. Preben Gudmandsen for careful reading and criticism of the manuscript. The English translation has been revised by Mr. Oscar Kasch, Sworn Translator and Interpreter.

APPENDIX

Calculation of F_x and F_y for a Homogeneous Ring Quasi-Array of Tangential Dipoles

By transforming the expression for F_x given in (14) we find

$$\begin{aligned}
F_x &= -\frac{1}{2\pi}e^{iH\phi}\int_{-\phi}^{2\pi-\phi}e^{i(Hv-z\cos v)}\sin(\phi+v)dv\\
&= -\frac{1}{2\pi}e^{iH\phi}\left\{\frac{1}{2i}\left[\int_0^{2\pi}e^{i[(H+1)v-z\cos v]}dv\right.\right.\\
&\quad\left.-\int_0^{2\pi}e^{i[(H-1)v-z\cos v]}dv\right]\cos\phi\\
&\quad+\frac{1}{2}\left[\int_0^{2\pi}e^{i[(H+1)v-z\cos v]}dv\right.\\
&\quad\left.\left.+\int_0^{2\pi}e^{i[(H-1)v-z\cos v]}dv\right]\sin\phi\right\}\\
&= \frac{1}{2}\left\{[J_{H-1}(z)+J_{H+1}(z)]\cos\phi\right.\\
&\quad\left.-i[J_{H-1}(z)-J_{H+1}(z)]\sin\phi\right\}e^{iH(\phi-\pi/2)}\\
&= \left[\frac{H}{z}J_H(z)\cos\phi-iJ_H'(z)\sin\phi\right]e^{iH(\phi-\pi/2)}.
\end{aligned} \tag{36}$$

In a similar way, the expression for F_y given in (14) is transformed into the expression for F_y given in (15).

---

[23] W. W. Hansen and J. R. Woodyard, "A new principle in directional antenna design," Proc. I.R.E., vol. 26, pp. 333–345;1938.

[24] S. A. Schelkunoff, "A mathematical theory of linear arrays," *Bell Sys. Tech. Jour.*, vol. 22, pp. 80–107; 1943.

[25] D. G. Reid, "The gain of an idealized Yagi array," *Jour. IEE* (London), pt. IIIA, vol. 93, pp. 564–566; 1946.

Discussion on

"Design Procedures for Pi-Network Antenna Couplers"*

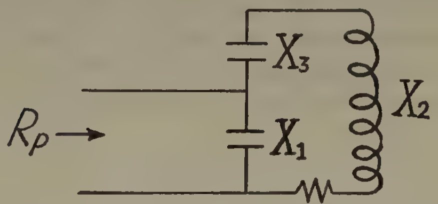
LEO STORCH

J. E. Wolfe:[1] Concerning the paper by Leo Storch on "Design Procedures for Pi-Network Couplers," I find that I am unable to agree with him as to the equivalence of Fig. 1(a) or (b) and (c). These may be equivalent as far as impedances are concerned, but if so, then I do not believe that they are equivalent as to Q_L. If this is true, then equation (1) is in error, also.

It seems to me that Q_L gives information as to bandwidth and tankcircuit efficiency, and should be defined as

$$Q_L = 2\pi \frac{\text{stored energy in circuit}}{\text{energy loss per cycle}}.$$

If this is true, (1) is correct only when X_3 is zero reactance. If the circuit of Fig. 1(c) is rearranged, one obtains



and the input impedance is related to the reactances at resonance in the following manner:

$$R_p = -\left(\frac{X_1}{X_1 + X_3}\right)^2 Q_L(X_1 + X_3 = -\frac{X_1^2}{X_1 + X_3} Q_L.$$

If (1) is incorrect, then I believe that this one fact renders the design procedure proposed impractical.

L. Storch: This is in reply to Professor Wolfe's comments on my paper.

Equation (1) defines Q_L[2] as $\frac{R_p}{-X_c}$; i.e., the ratio at the resonant frequency of the input impedance R_p to $(-X_c)$, the magnitude of the reactance of the tuning capacitor. Since (1) further requires that $X_1 = X_c$ and since all three circuits of Fig. 1 are proportioned by means of (3), (6), (7), and (10) to have the same resonant input impedance R_p, it is obvious from the above relationship, or (1), that Q_L of the three circuits is identical.

Professor Wolfe's troubles stem from his failure to differentiate between the Q of the circuit with the load connected, designated as loaded Q or Q_L, and a Q which is solely a figure of merit for the coil and should be as high as possible.

This is the only conclusion that can be drawn from the second paragraph of Professor Wolfe's letter. First Q_L is erroneously related to tankcircuit efficiency. Then Fig. 1(c) is redrawn, with the load Z_A omitted and a loss component added in series with the coil. Nevertheless, the input impedance of this unloaded circuit is shown as R_p. This is carried over into the second equation, in which Q_L is erroneously used as a measure of dissipation in the coil, and is involved in indicating the input impedance of a tapped, unloaded tuned circuit as R_p. In this connection the use of neither R_p nor Q_L in that equation is justified. Also, the diagram as well as the equation lack any significance as far as the material in my paper is concerned.

J. E. Wolfe: shall answer Mr. Storch's remarks in the order in which they are presented.

First, I am aware of the fact that his Q_L is the loaded Q and that he has defined his particular concept of loaded Q by (1). I shall show that this concept of loaded Q is not consistent with the concept of Q as applied to harmonic reduction, or "flywheel effect." First, the power into the three circuits of Fig. 1 must be the same; therefore, the energy loss per cycle, which includes coil as well as output losses, must be the same for all circuits. An analysis of the circuit will show that its stored energy is the same as that calculated in the capacitors at the instant when their voltages are maximum. So, if assuming that X_1 and X_3 are capacitive reactances and $X_1 = X_C$, we will have more stored energy in X_1 and X_C. However, Fig. 1(c) will have more stored energy than Fig. 1(a) and (b) as a result of extra energy stored in X_3.

The next disagreement seems to come from the interpretation placed on the equation

$$Q = 2\pi \frac{\text{stored energy}}{\text{energy loss per cycle}}.$$

This equation applies as the fundamental definition of Q for any circuit no matter how complex either loaded or unloaded. If we are to determine loaded Q, it is necessary to insert as energy loss per cycle all losses including power output since, as far as the circuit is concerned, power output is part of its losses.

At this point I should like to say that I referred previously only to loaded Q and not to the figure of merit of a coil to which Mr. Storch refers.

Concerning the effect of loaded Q on tank-circuit efficiency, I refer to Equations 7–26 on page 383 of the third edition of "Radio Engineering" by F. E. Terman. In this equation, $N = \frac{Q_1 - Q_2}{Q_1} \times 100$, Q_2 is Q_L in Mr. Storch's terminology, and Q_1 is the coil figure of merit.

---

* L. Storch, "Design procedures for pi-network antenna couplers," PROC. I.R.E., vol. 37, pp. 1427–1432; December, 1949.

[1] Department of Electrical Engineering, Kansas State College, Manhattan, Kansas.

[2] The "loaded" Q in paragraph 2, page 1428. See footnote reference*.

Referring to the figure in my letter, the resistor was supposed to be equivalent to Mr. Storch's R_S. This resistance represents both coil losses and a series representation of Z_A, which includes the effect of power output. It is most convenient to regard Z_A as a pure resistance (which it is not likely to be) since it may otherwise contribute to the stored-energy term and thereby affect the Q_L still further from the value it has in Mr. Storch's paper. In case Z_A has a capacitive component, X_3 may conceivably be altered to take this effect into account. This interpretation may be placed on the figure in my letter; hence, it does apply directly to Mr. Storch's problem.

In conclusion let me say that the most significant effect that will result as a consequence of the use of Mr. Storch's equations is an erroneous idea of the bandwidth of the plate circuit of the tube.

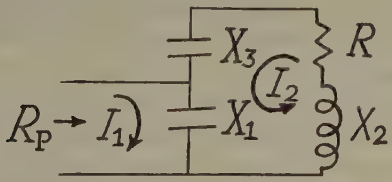
L. Storch: As regards making final comments, it would be helpful if Professor Wolfe supplied the derivation of his equation

$$R_p = -\left(\frac{X_1}{X_1 + X_3}\right)^2 Q_L(X_1 + X_3)$$

and specified Q_L in terms of the elements in his diagram.

J. E. Wolfe: The derivation of the equation Mr. Storch referred to follows.

Since it is possible for certain types of load as well as the components in the coupler to store energy, let us assume that the load in Fig. 1(c) is a pure resistance and, furthermore, that it is a large resistance compared to X_3. This allows us to use X_3 and R in my equivalent diagram to represent the parallel combination of Mr. Storch's X_3 and load resistance.



The coupler may be assumed lossless in which case I^2R represents useful output and Q_L will be X_2/R, or X_1+X_3/R, the loaded Q. If Q_L is large, I_1 may be neglected in comparison with I_2 for calculating the drop in X_1.

$$P_{\text{in}} = P_0$$

$$\frac{V_{X_1}^2}{R_p} = I_2^2R = \left(\frac{V_{X_1}}{X_1}\right)^2 \frac{X_1 + X_3}{Q_L}.$$

Hence,

$$R_p = \frac{X_1^2}{X_1 + X_3} Q_L,$$

the formula I quoted in my letter.

Thus it seems that as long as there is an equivalent X_3, we cannot use (1) in Mr. Storch's paper.

Leo Storch: By his latest remarks, Prof. Wolfe has confirmed my diagnosis that he is dealing with Q_L indiscriminately. In what follows, it will be convenient to label Prof. Wolfe's Q_L as Q_{LW}, in order to distinguish it from Q_{LS}, i.e. the Q_L of my paper.

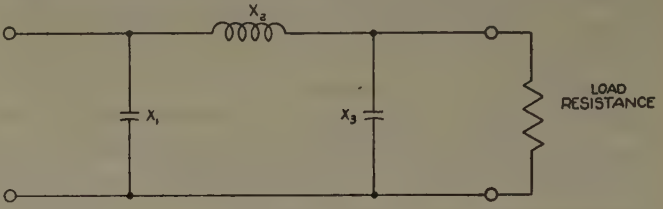


Fig. I.

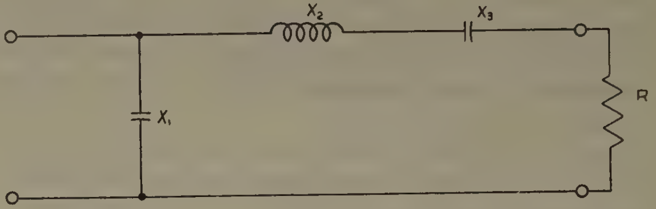


Fig. II.

The circuit underlying Prof. Wolfe's derivation is shown in Fig. I, which he replaces by the equivalent circuit of Fig. II on the assumption that the load resistance is much larger than $|X_3|$. Its input impedance at resonance he calculates as:

$$R_p \cong \frac{X_1^2}{R},$$

which agrees with the expression in my paper (R corresponds to my R_s). At this point, he introduces as Q_L:

$$Q_{LW} = \frac{X_2}{R} = -\frac{X_1 + X_3}{R}.$$

This Q_{LW} is definitely at variance with the Q_L of my paper ((1) and (3)):

$$Q_{LS} = \frac{R_p}{-X_1} = -\frac{X_1}{R_s}$$

or in Prof. Wolfe's notation:

$$Q_{LS} = -\frac{X_1}{R}.$$

Of course, substitution for R in terms of a different formula for Q_L changes the appearance of the equation for R_p from:

a) in terms of Q_{LS}: $R_p \cong \dfrac{X_1^2}{R} = -X_1Q_{LS}$

to:

b) in terms of Q_{LW}: $R_p \cong \dfrac{X_1^2}{R} \cong -\dfrac{X_1^2}{X_1 + X_3}Q_{LW}$.

Consequently, it is deceiving and incorrect to present eq. (b) for R_p, without qualifying Q_L at the same time.

It is baffling when Prof. Wolfe states: "I am aware of the fact . . . that he has *defined* (my italics) his particular concept of loaded Q by (1)," after having stated that, "(1) is in error," and "(1) is incorrect." Consequently, Prof. Wolfe is on record as maintaining that it is possible for a definition to be inherently incorrect and in error. This would seem to violate the dictates of elementary logic.

Although Prof. Wolfe asserts that he is aware of the definition of Q_L in my paper, he continues with his remarks as if he were not. This is indicated by such meaningless statements as: "(1) is correct only when X_3 is zero reactance," and more recently: "as long as there is an equivalent X_3, we cannot use (1) in Mr. Storch's paper." The correct statement is that Q_{LW} coincides with Q_{LS} only when $X_3=0$. For this case, the pi-network has degenerated to an L-network, since $X_3=0$ in Fig. II corresponds to $X_3=\infty$ in Fig. I.

Prof. Wolfe also appears to attribute deficiencies to Q_{LS}, of which it is quite innocent, but which are characteristic of Q_{LW}. His statement that "Z_A . . . may . . . affect the Q_L still further from the value it has in Mr. Storch's paper" is quite incorrect. Q_{LS} is completely independent of Z_A since R_p and X_1 are fixed. By way of contrast, Q_{LW} changes with both resistive and reactive components of Z_A since X_2 and X_3 are functions of Z_A.

Prof. Wolfe appears to misunderstand the real meaning of his own Q_{LW} in more instances than this one.

He states, for example, that when Q_{LW} is large:

$$R_p \cong \frac{X_1^2}{R}.$$

This is not necessarily so. In the exact form, the resonant input resistance of the network in Fig. II is given by:

$$R_p = R + \frac{(X_2 + X_3)^2}{R},$$

where

$$X_1 + X_2 + X_3 + \frac{R^2}{X_2 + X_3} = 0.$$

When $|X_2+X_3|$ is small although X_2 is large, the term "R" is not negligible compared to $(X_2+X_3)^2/R$. To illustrate by means of a simple, numerical example, let: $R=10$, $X_2=1000$, $X_3=-990$, so that the circuit resonates when $X_1=-20$ (values are in ohms). Applying Prof. Wolfe's formula to this case, which corresponds to Q_{LW} being as high as 100:

$$R_{pw} \cong \frac{X_1^2}{R} \cong -\frac{X_1^2}{X_1 + X_3} Q_{LW} = \frac{400}{1010} \cdot 100 = 39.6 \text{ ohm.}$$

It deviates substantially from the correct value:

$$R_p = 10 + \frac{100}{10} = 20 \text{ ohm.}$$

In comparison, the approximation $R_p \cong X_1^2/R_s$ is always justified when Q_{LS} is high. Fundamentally, Q_{LW} is an internal Q and is appropriately described as an effective coil-Q, since it refers only to that part of the reactance which is inductive. Q_{LS}, on the other hand, is based on the total reactance which bridges at resonance the input terminals in a single branch.

When Prof. Wolfe relates Q_L to bandwidth, he presumably has in mind that:

$$f_2 - f_1 = \frac{f_0}{Q_{LW}}.$$

f_1, f_2: the frequencies, at which

$$|Z| = 0.707\,|Z|\,(f = f_0).$$

This analogy to a simple LC, parallel-tuned circuit is fallacious. Since $Q_{LW} = -[(X_1+X_3)/R]$, its value remains fixed when X_1 and X_3 are modified individually such that their sum is kept constant, although the behavior of the circuit as a function of frequency is being changed by this process. Therefore the single parameter Q_{LW} is inadequate as an index of the frequency-characteristic. Irrespective of the definition of Q_L, it would take two additional parameters to describe the frequency-characteristic completely in the case of complex load impedances.

There has also been some discussion of Q_L as related to tank-circuit efficiency. In the case of a non-dissipative coupling network, which is the case treated in my paper and also described by Prof. Wolfe (see his latest communication), the tank-circuit efficiency is always 100 per cent and independent of Q_L (i.e., Q_{LW} or Q_{LS}). This follows also from Terman's equation, which was cited by Prof. Wolfe. If dissipation is to be taken into consideration, an outline of the proper procedure will be found in footnote 1 on p. 1427 of my paper.

It should be carefully noted that Prof. Wolfe's specification or a purely resistive load, his assumption that $R_A \ll |X_3|$, and the resultant treatment of the circuit of Fig. II as equivalent to that of Fig. I are due solely to his personal inclinations, and do not in any way reflect on the scope or methods of my paper. In this connection, the diagram in his second communication, deprived of any labelling of the resistor and without any indication or legend as to his arbitrary and unnecessary approximation, was lacking in precision and very misleading. Its identification as an unloaded tuned circuit was most reasonable under the circumstances. However, Prof. Wolfe's subsequent amendments require only the designation of Q_{LW} as an effective coil-Q rather than as an ordinary coil-Q but do not affect any of the previous conclusions.

It would have sufficed to reject categorically Prof. Wolfe's arguments as irrelevant, since he has based them on a different definition of terms in disregard of the precepts of logic and critical reviewing.[1] It appeared to be less pedantic on my part and more instructive for the readers to trace Prof. Wolfe's reasoning and to probe the meaning of his remarks. Having done so, I conclude that his criticisms are misdirected and that, furthermore, the statements concerning his own Q_{LW} wilt under scrutiny. If Prof. Wolfe still feels that an area of disagreement exists, I suggest that the Institute append a referee's opinion to the discussion.

---

[1] "Agreement about the use of words is the absolutely indispensable condition for genuine agreement or disagreement about the facts being discussed." "How to Read a Book," by Mortimer J. Adler, New York, 1940, p. 253.

I would like to thank Prof. Wolfe for the interest he has shown in my paper, and I hope that he will find profitable applications for actual design procedures, now that preliminary concepts have been fully explored.

The Optimum Linear Array for a Single Main Beam*

D. R. RHODES†

Summary—**For a linear array having any given number of elements it is shown that an optimum single-beam endfire pattern can be produced by proper choice of current distribution and element spacing.**

THE DOLPH[1]-TCHEBYSCHEFF CURRENT distribution for a linear array produces the minimum beamwidth possible for a given side lobe level when all elements are fed in-phase. For an array of dipoles, the requirement that all elements be fed in-phase results in two main beams in the broadside directions. For many array applications this can be reduced to a single main beam by placing a suitable reflector on one side of the array; however, it will be shown in this paper that a linear array exists for producing a single main beam from the array alone, with the minimum beamwidth possible for a given number of elements and side lobe level. The minimum beamwidth for a single main beam is always greater than that produced by Dolph's array, however. Two other principal differences will appear, namely that the optimum single-beam pattern is possible only for a certain specified spacing between elements, and that the single-beam pattern is endfire rather than broadside.

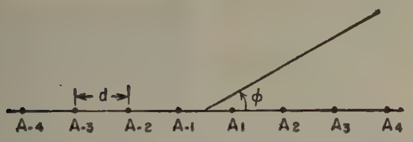


Fig. 1—Linear array of eight point sources with a symmetrical amplitude distribution.

Dolph's example of an eight element array, Fig. 1, with a side lobe level of 25 decibels will be used for illustration. For maximum radiation in any direction $\phi=\zeta$ it is necessary that the elements be excited with a uniform phase progression, the field pattern being given by

$$E(\phi) = 2\sum_{n=1}^{4} A_n \cos\left[(n-\tfrac{1}{2})\beta d(\cos\phi-\cos\zeta)\right]$$

Minimum beamwidth is obtained by first expressing $E(\phi)$ as a polynomial and then choosing the A_n's[2] in such a way that it reduces to the required Tchebyscheff polynomial. The A_n's are independent of ζ and d. For this example the A_n's are found to be

$$A_4 = 2.40$$
$$A_3 = 3.71$$
$$A_2 = 5.35$$
$$A_1 = 6.35.$$

The relative amplitudes of the sources are then

2.40, 3.71, 5.35, 6.35, 6.35, 5.35, 3.71, 2.40

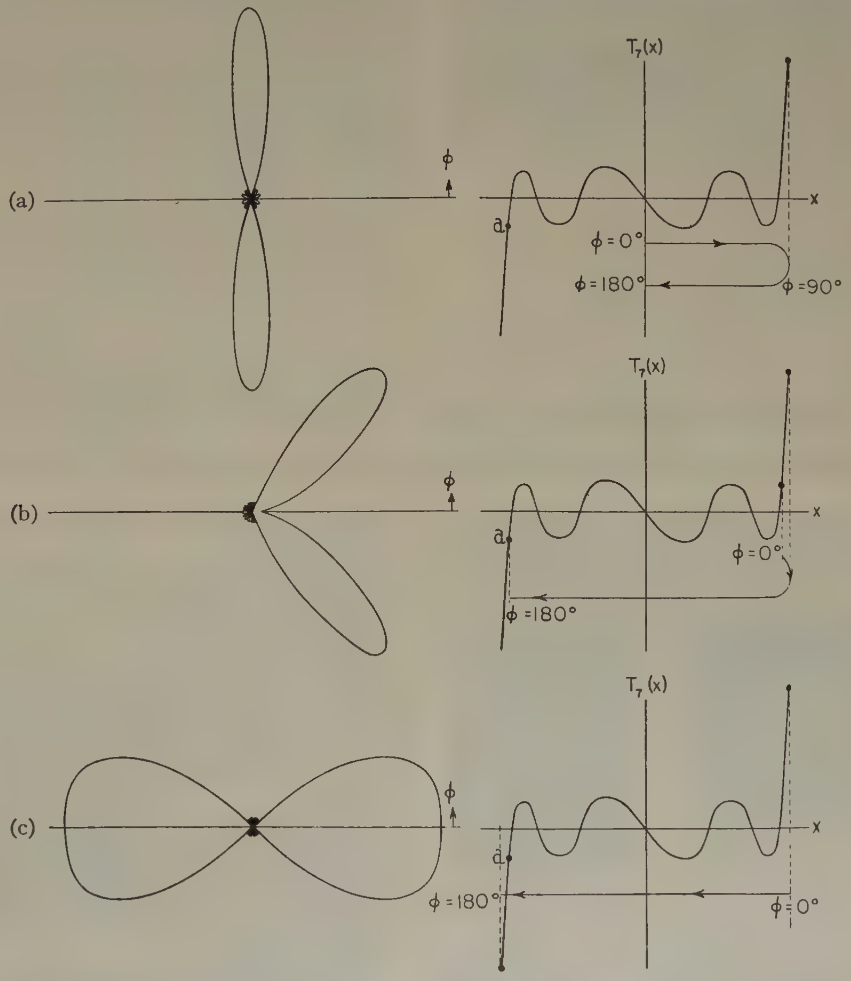


Fig. 2—Radiation patterns of an eight element array with element spacing $d=\lambda/2$. The excitation amplitudes are proportional to the coefficients of the Tchebyscheff polynomial. The phase difference between elements is such that the main beam occurs at (a) $\phi=90°$, (b) $\phi=46°$, and (c) $\phi=0°$ The Tchebyscheff polynomial corresponding to each polar pattern is shown.

---

* Decimal classification: R125.1×R325.11. Original manuscript received by the Institute May 26, 1952; revised manuscript received October 6, 1952. The work described in this paper was supported, in part, by a contract between the Wright Air Development Center and the Ohio State University Research Foundation.

† Dept. of Electrical Engineering, Ohio State University, Columbus, Ohio.

[1] C. L. Dolph, "A current distribution for broadside arrays which optimizes the relationship between beamwidth and side lobe level," Proc. I.R.E., vol. 34, pp. 335–348; June, 1946.
H. J. Riblet, Proc. I.R.E., vol. 35, pp. 489–492; May, 1947.

[2] For an example of the method for calculating the A_n's see J. D. Kraus, "Antennas," McGraw-Hill Book Co., N. Y., pp. 97–107; 1950.

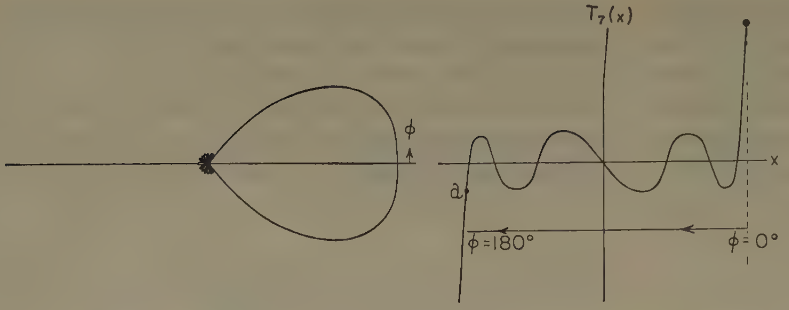


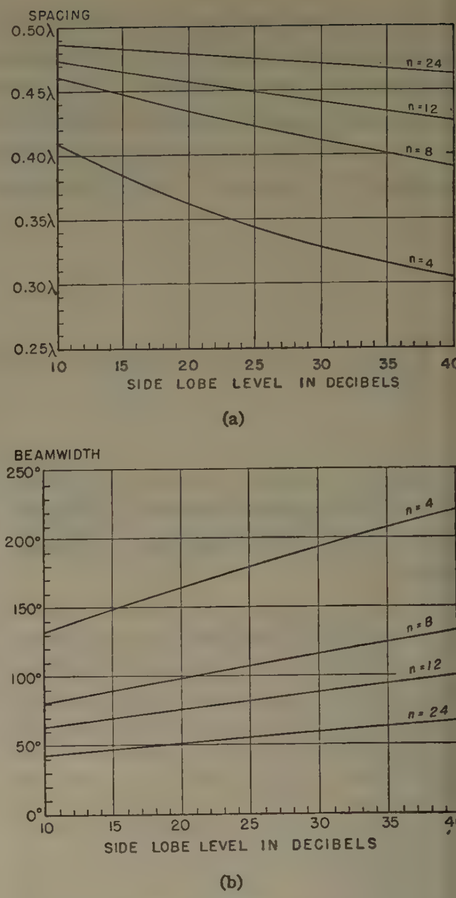
Fig. 3—Radiation pattern of the array of Fig. 2(c) when the element spacing is reduced to such a value that the back lobe is reduced to the side lobe level.

Consider the case where spacing between elements is $d=\lambda/2$. For the broadside case, $\zeta=90°$, the pattern is as shown in Fig. 2(a). The correspondence between the polar pattern and the Tchebyscheff polynomial as ϕ goes from 0° to 180° is indicated on the graph of the polynomial. As the phase difference between the elements increases, the two main lobes tilt toward the array axis as shown in Fig. 2(b). If ζ is reduced until the angle $\phi=180°$ corresponds to a point to the left of point a on the Tchebyscheff polynomial, two back lobes appear which exceed the side lobe level. At $\zeta=0°$ the two back lobes merge to form a single lobe of strength equal to that of the single lobe formed by the original two main lobes, as shown in Fig. 2(c).

The two lobe endfire pattern can now be reduced to a single lobe pattern by reducing the spacing between elements until the angle $\phi=180°$ corresponds to the point a on the Tchebyscheff polynomial, Fig. 3.

That the single lobe pattern in Fig. 3 is the optimum pattern for an eight element array with side lobes 25 decibels down from the main lobe is seen from the following considerations. The relative amplitudes of the eight sources are fixed by the side lobe level of the Tchebyscheff polynomial, the phase difference between elements is fixed by the requirement that maximum radiation be in the endfire direction, and the spacing between elements is fixed by the requirement that the back lobe be reduced to the side lobe level. A change in any of these three parameters will result in a pattern which cannot be represented by a Tchebyscheff polynomial, or which does not have the required side lobe level, or which has more than a single maximum above the side lobe level.

The relationship between side lobe level and element spacing is shown in Fig. 4(a). The resulting beam width as a function of side lobe level is shown in Fig. 4(b).



(a)

(b)

Fig. 4—(a) Element spacing required, and (b) beamwidth between first nulls, for the optimum single beam pattern produced by an array of n elements with a given side lobe level.

Contributors to Proceedings of the I.R.E.

Nelson M. Blachman (A'50) was born in Cleveland, Ohio, in 1923. He received the B.S. degree in physics at Case School of Applied Science (Case Institute of Technology) in 1943. From 1943 to 1945 he was a member of the theory and the transducer groups at the Harvard Underwater Sound Laboratory, working on systems for the detection of submarines. For this work he received a Naval Ordnance Development Award.

N. M. Blachman

In 1945 Mr. Blachman joined the Central Communication Research project at Cruft Laboratory, Harvard University, to investigate the relative merits of AM and FM communication systems. His work continued under auspices of the Harvard Electronics Research Laboratory.

During the year 1946 Mr. Blachman received a John Tyndall scholarship for the graduate study of physics, and a Gordon McKay scholarship in Engineering Sciences and Applied Physics at Harvard. Following graduation with the A.M. and Ph.D. degrees from Harvard in 1947, he joined the Accelerator Project of the Brookhaven National Laboratory where he was concerned with the theory and design of the proton synchrotron.

Since 1951 Dr. Blachman has been working in the Computer Branch of the Office of Naval Research in Washington, D. C. He is the author of numerous papers in the *Rev. of Sci. Instr.*, the *Phys. Rev.*, and the *Jour. of Appl. Phys.*

Mr. Blachman is a member of the A.P.S., the Federation of American Scientists, the American Association for the Advancement of Science, and Sigma Xi.

Lamont V. Blake (A'42–M'45) was born in Somerville, Mass., on November 7, 1913. He received the B.S. degree from the University of Massachusetts in 1935, and the M.S. degree in physics from the University of Maryland in 1950.

L. V. Blake

From 1937 to 1940 Mr. Blake was employed by the Arkansas Power & Light Company as a radio interference investigator. Since 1940 he has been associated with the Naval Research Laboratory, where he is now head of the Radar System Section, Search Radar Branch, Radio Division II. During most of World War II he was engaged in work on radar countermeasures. Before that time, and since, he has

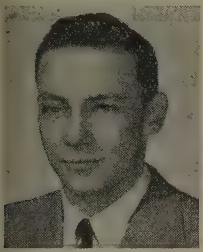
Contributors to Proceedings of the I.R.E.

been concerned with naval search radar research and development.

Mr. Blake is currently teaching an off-campus graduate-undergraduate course, "Principles of Radar," sponsored by the University of Maryland Department of Electrical Engineering.

Mr. Blake is a member of Sigma Pi Sigma, the American Association for the Advancement of Science, and the American Physical Society. He is also a registered professional engineer of the District of Columbia.

◆



J. B. Chatten

John B. Chatten (S'50–A'51) was born in New York, N. Y., on November 18, 1927. He received the B.S. degree in electrical engineering from the Massachusetts Institute of Technology in 1950.

Since 1950 Mr. Chatten has been a research engineer with the Philco Corporation, where he has worked on color television and color measuring apparatus.

◆

E. H. Fritze

E. H. Fritze (S'48–A'50–M'53) was born in St. Paul, Minnesota, on January 15, 1924. He received the B.E.E. degree from the University of Minnesota in 1944 and the M.S. degree in Electrical Engineering from the University of Wisconsin in 1948. Mr. Fritze served in the U. S. Navy from 1944 to 1946, during which time he attended courses in radar engineering at the Massachusetts Institute of Technology and later was assigned duty in airborne electronics.

After release from the service, he was employed by the Boeing Aircraft Company as a test instrumentation development engineer. In 1948, Mr. Fritze joined the Collins Radio Company. He has since been engaged in the development of feedback control systems and analog computers for radar and aircraft control applications, and presently heads a research and development group working in this field.

He is a member of Tau Beta Pi and Eta Kappa Nu.

For a photograph and biography of Mr. J. F. Fisher, see page 399 of the March issue of the Proceedings of the I.R.E.

◆

H. L. Knudsen

H. Lottrop Knudsen was born in Holstebro, Denmark on December 8, 1917. He received the M.S. degree in telecommunication engineering from The Royal Technical University of Denmark in Copenhagen in 1942. Immediately following graduation he worked as an assistant in teletechnics and the electromagnetic theory at Chalmers Technical University at Gothenburg, Sweden. From 1943 to 1946 he was engaged as an engineer at the Sieverts Kabelverk in Sundbyberg, Sweden, where he worked on problems concerning power cables, especially their heating, induced voltages therein, and oil flow in oil-filled cables. In the latter year he substituted for the professor in electromagnetic theory at Chalmers Technical University.

From 1946 to 1947 Mr. Knudsen was a student of applied physics at Harvard University, receiving the M.S. degree. In 1948 he returned to Denmark to take up teaching duties at the Royal Technical University. He has been concerned principally with the waveguide theory, antenna theory, and other branches of applied mathematics. He has published papers on these subjects and a textbook on electromagnetic theory.

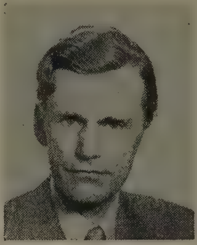
◆

Gerald Herzog

Gerald B. Herzog was born on August 19, 1927, in Minneapolis, Minn. He attended the University of Minnesota where he received the B.E.E. degree in 1950 and M.S.E.E. degree in 1951.

Since joining the staff of RCA Laboratories Division, Princeton, in 1951, Mr. Herzog has worked on low temperature studies of semiconductors, transistor test equipment, and presently is engaged in studies of transistor circuits.

Mr. Herzog is a member of Eta Kappa Nu.



Gunnar Hok

Gunnar Hok (A'31–SM'46) was born in Eskilstuna, Sweden on March 29, 1903. He received the E.E. degree from the Royal Institute of Technology in Stockholm, Sweden in 1926. In 1931 and 1932 he visited Harvard University as a fellow of the American Scandinavian Foundation and did graduate work in electrical communication.

Mr. Hok was an assistant engineer in the Radio Bureau of the Swedish Telegraph Board from 1927 to 1933 and development engineer for Svenska Radio A.B., Stockholm from 1933 to 1937. In 1939 he joined the Gray Manufacturing Company, Hartford, Connecticut as a development engineer. He served as an instructor in electrical engineering at New York University from 1941 to 1943 and as a research associate at the Radio Research Laboratory of Harvard University from 1943 to 1946. He was employed as a research physicist at Wesleyan University, Middletown, Connecticut from 1946 to 1948, when he accepted his present position as research engineer and lecturer in electrical engineering at the University of Michigan.

Mr. Hok is a member of Sigma Xi and A.P.S.

◆

For a photograph and biography of J. G. Linvill, see page 727 of the June, 1952 issue of the Proceedings of the I.R.E.

◆

R. D. Lohman

R. D. Lohman was born in Chicago, Ill., on August 19, 1924. He served in the armed forces during World War II, and in 1946 entered the Electrical Engineering curriculum at Norwich University. There he received the B.S. degree in E.E. in 1949.

Mr. Lohman obtained an M.S. degree in E.E. from North Carolina State College in 1951 and joined the RCA Laboratories Division at Princeton in June of that year.

Since joining RCA, Mr. Lohman has been engaged in semiconductor and transistor research. He is a member of Eta Kappa Nu and Sigma Xi.

Contributors to Proceedings of the I.R.E.

R. C. Moore

Robert C. Moore was born on January 3, 1912, in Pontiac, Ill. He received the B.S. degree in electrical engineering in 1933 from the University of North Dakota, and the S.M. degree in electrical engineering in 1934 from the Massachusetts Institute of Technology. He received the degree of B.A. in physics from Oxford University in 1936.

He has been with the Philco Corporation since 1937, principally in television development and research. At present he is a section engineer in the Research Division, concerned with television systems and standards.

Mr. Moore is a member of the Franklin Institute.

❖

Delmar V. Payne

Delmar V. Payne (S'48–A'51) was born in Kansas City, Kansas in 1924. He obtained the B.S. and M.S. degrees in electrical engineering in 1950 and 1951, respectively, from Kansas State College after serving in the U. S. Army for three years. Upon graduation, Mr. Payne was employed by the Bendix Aviation Corporation, Research Laboratories, as a research engineer.

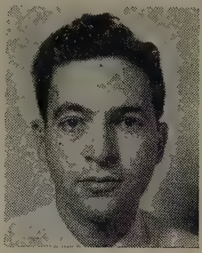
Mr. Payne is a member of the Phi Kappa Phi, Pi Mu Epsilon, and Eta Kappa Nu societies.

❖

Donald R. Rhodes

Donald R. Rhodes was born in Detroit, Michigan, on December 31, 1923. He received the degrees B.E.E. and M.Sc. from Ohio State University in 1945 and 1948, respectively. Since 1945 he has held the position of Research Associate with the Ohio State University Research Foundation, with occasional appointments as a part time instructor in the department of electrical engineering. At the present time Mr. Rhodes is engaged in research on certain aspects of the theory of radiation from antennas.

❖



M. Strasberg

Murray Strasberg was born August 11, 1917 in New York, N. Y. He received the B.S. degree in physics in 1938 from the College of the City of New York and the M.S. degree in 1948 from the Catholic University of America, and is now completing work for the Ph.D. degree at the latter.

From 1942 to 1949, and again since 1952, Mr. Strasberg has been employed at the David Taylor Model Basin, first as head of the Instruments and Measurements Section of the Acoustics Division, and now as head of the Hydrodynamic Noise Section of the Hydrodynamics Division. He has been engaged in the design of high-power sound sources and electroacoustic instrumentation, underwater acoustic measurements, and research on the generation of various types of noise. From 1949 to 1952 he was head of the Noise Reduction Section of the Research Division of the Bureau of Ships and acted as Consultant in Acoustic Noise, Shock, and Vibration.

Mr. Strasberg is a member of A.P.S., the Acoustical Society of America, and Sigma Xi. He is also a member of the Subpanel on Acoustic Noise Reduction of the Electronics Committee of the Research and Development Board.

❖

G. C. Sziklai

G. C. Sziklai (A'41–M'43–SM'43) was born in Budapest, Hungary, on July 9, 1909. He received the absolutorium (equivalent to the M.S. degree) in 1930 from the Pazmany University of Budapest. He was an exchange student at the Technische Hochschule in Munich, Germany, in 1928. In 1931 he joined the Aerovox Corporation, where he became assistant chief engineer. He was the chief engineer of the Polymet Manufacturing Corporation from 1932 to 1935.

During 1934 Mr. Sziklai spent a half year in Europe providing consultation to electrical component manufacturers in London and Paris. From 1934 to 1939 he was on the research staff of the Micamold Radio Corporation.

Mr. Sziklai joined the industry service division of the Radio Corporation of America in 1939, and later transferred to the Bloomington division of the same company. Since 1942, he has been in the television research section of the RCA Laboratories at Princeton, N. J.

Mr. Sziklai is a member of the American Physical Society, Optical Society of America, and Sigma Xi.

❖

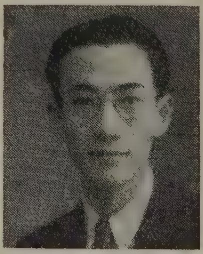
W. B. Wrigley

William B. Wrigley was born on August 7, 1918, in Vancouver, Canada. After receiving a B.S. degree in engineering physics from Lehigh University in 1940, he joined the engineering staff of the Radio Corporation of America in Camden, N. J.

From 1941 to 1946 he served as an officer of the U. S. Army in this country and Europe. He returned to RCA, then in 1947 went to Georgia to experiment with the prefabricated house business.

In 1948 he joined the research staff of the Engineering Experiment Station at Georgia Tech, receiving the M.S. degree in electrical engineering in 1949. He was recalled to active duty in 1951 and served as a Lt. Colonel at the Air Force Cambridge Research Center until 1952, when he returned to research activities at Georgia Tech.

❖



Chai Yeh

Chai Yeh (A'48–SM'51) was born on September 21, 1911 in China. He received the B.S. degree in electrical engineering in 1931 from the National Chekiang University, China. He received the M.S. degree in 1934 and the D.Sc. degree in electrical communication engineering in 1936 from Harvard University. Dr. Yeh was an assistant in physics and communication engineering at Harvard University from 1935 to 1936. From 1937 to 1948, he was professor at National Tsing Hua University, Peiping, China. From 1948 to date he has been a Visiting professor at the University of Kansas, Lawrence, Kansas. Dr. Yeh is a member of Sigma Xi, and of Tau Beta Pi.

Correspondence

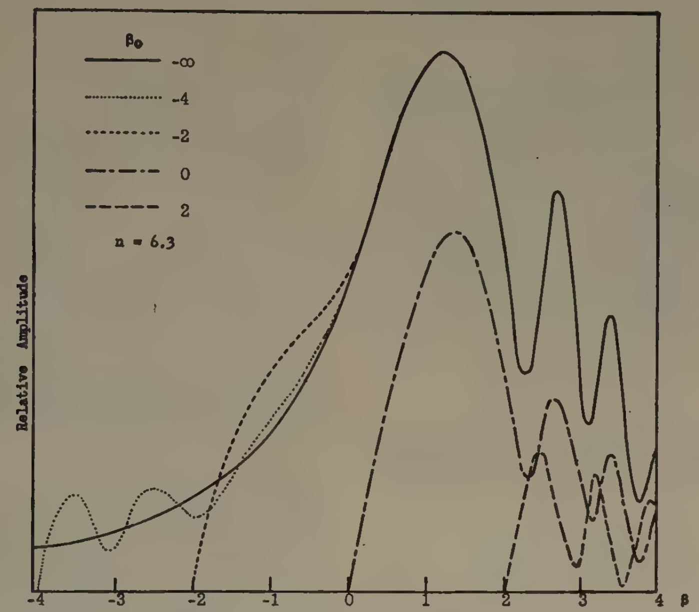


Fig. 1—Response of a resonant circuit to an applied signal varying linearly with frequency.

Network Definitions*

Having occasion to refer to the article, "Standards on Circuits: Definition of Terms in Network Topology,"[1] I was led to reflect again on the idea of having parts of a system which are *combined* but not *connected*. A network is defined as a combination of elements, but parts of the network may be separate in the sense that they are not joined by a path formed of series-connected two-terminal elements.

This, surely, is just an ingenious device to accord with the academic custom that when a mutual inductance forms the sole link between two parts of a network the data are specified in incomplete form, thus excluding the possibility of determining the potential difference between a point in one part and a point in the other part. Although this is customary and labor-saving, there are a number of arguments against it:

1. Any incompleteness of data about a system should be made explicit, not disguised.
2. As soon as we draw the structurally dual circuit, the separation vanishes because the common "space" in which the parts of the given circuit were set becomes a common node of the dual circuit.
3. Although the data may be left incomplete in academic exercises, the missing parameter may be vital in engineering practice. For example, whenever we use an "isolating transformer" to separate a circuit accessible to the user from a circuit at high potential above earth, the potential of the protected circuit will not be left to chance.
4. If we could define "connected" as "conductively connected," this would reasonably accord with nontechnical use of the terms. But we are bound to allow a series capacitor to rank as a connection, and if the electric field of a capacitor is allowed to rank as part of a circuit, why not also the magnetic field of an inductor?
5. Closely associated with the fourth reason is the writer's objection to the attitude that an engineer need only know his electrostatics and a rule-of-thumb $E=-Ldi/dt$ (or is it *plus* Ldi/dt as some seem to prefer?), and that *electromagnetism* is an esoteric subject for physicists only.

Changes in standards are never welcome (e.g., the upset caused by the adoption of mks units); but since the trend is to the unification of circuit theory and field theory through the intermediaries of transmission lines and waveguides, it might be advisable to reorganize our circuit ideas roughly as follows:

A *network* is a system of elements capable of transferring electrical energy from some branches to others. (The transfer is not always reciprocal between branches, e.g., valve amplifiers.)

In calculating the *nullity* of a network, allow for the fact that if there are parts which are joined in only by magnetic coupling (and the potentials of these parts relative to the potential-datum of the rest of the network are not specified), the network will appear to have additional degrees of freedom corresponding to these unspecified potentials.

D. A. Bell
Dept. of Electrical Engineering
University of Birmingham
Birmingham, England

---

* Received by the Institute, October 9, 1952.

[1] "Standards on circuits: definitions of terms in network topology, 1950," Proc. I.R.E., vol. 39, pp. 27–29; January, 1951.

A Method of Obtaining 90° Phase Shift of Constant Amplitude*

It is sometimes desired to add a 90° phase shift to a complex audio signal. Beginning with the signal

$$e_{\text{in}} = 2A \cos(\omega_a t + \theta_a) + 2B \cos(\omega_b t + \theta_b) + \cdots,$$

we attempt to achieve

$$e_{\text{out}} = 2A \sin(\omega_a t + \theta_a) + 2B \sin(\omega_b t + \theta_b) + \cdots.$$

Passage of the input signal through a simple RC phase-shifting network is unsatisfactory because the output amplitude of such a network is a function of frequency.

To obtain the desired result, the following four steps may be employed:

1. We first amplitude modulate a sinusoidal carrier signal, $C \sin \omega t$, obtaining

$$e_1 = [C + 2A \cos(\omega_a t + \theta_a) + 2B \cos(\omega_b t + \theta_b) + \cdots] \sin \omega t.$$

Expanding,

$$\begin{aligned} e = {} & C \sin \omega t + A \sin(\omega t + \omega_a t + \theta_a) \\ & + A \sin(\omega t - \omega_a t - \theta_a) \\ & + B \sin(\omega t + \omega_b t + \theta_b) \\ & + B \sin(\omega t - \omega_b t - \theta_b) + \cdots. \end{aligned}$$

2. A high-pass filter, with cutoff frequency ω, is now used to eliminate the lower sidebands. The output of the high-pass filter is

$$\begin{aligned} e_2 = {} & C \sin \omega t + A \sin(\omega t + \omega_a t + \theta_a) \\ & + B \sin(\omega t + \omega_b t + \theta_b) + \cdots. \end{aligned}$$

3. A large-amplitude reference signal of frequency ω but 90° out of phase with C is next added:

$$\begin{aligned} e_3 = {} & C \sin \omega t + A \sin(\omega t + \omega_a t + \theta_a) \\ & + B \sin(\omega t + \omega_b t + \theta_b) + \cdots \\ & + R \cos \omega t. \end{aligned}$$

4. We now detect the signal of step 3. If R is large compared to the other signal components, the peaks of the RF signal occur at $\omega t = 0$, 2π, and so forth. The modulation envelope output of the detector is therefore found by setting $\omega t = 0$ in e_3, or

$$\begin{aligned} e_4 = {} & A \sin(\omega_a t + \theta_a) + B \sin(\omega_b t + \theta_b) \\ & + \cdots + R. \end{aligned}$$

The desired 90° phase shift has thus been introduced while retaining the original amplitude components except for a constant factor. A coupling condenser, of course, can be used to eliminate the dc component, R.

Sid Deutsch
Polytechnic Research and Development Co.
Brooklyn, N. Y.

---

* Received by the Institute, January 27, 1953.

Correspondence

Frequency Spectrum of a Pulled Oscillator*

Buchanan[1] gives the expression for pulled oscillation of an oscillator whose frequency is disturbed by a stable signal:

$$= \frac{1 - |\sin\beta|}{\cos\beta}\cos\xi + \sum_{m=1}^{\infty} A_{2m}\cos(\xi \pm 2m\psi),$$

where the frequency of ξ is that of the injected signal and that of $\xi+2\psi$ (i.e., $m=1$) is the oscillator frequency displaced by pulling; $m>1$ give the sidebands seen on the spectra reproduced by Buchanan.

His expression for A_{2m} contains a hypergeometric function. He failed to observe that this particular function can be written as a closed algebraic expression. From the theory of hypergeometric functions,

$$F\left\{\frac{m}{2}, \frac{m+1}{2}; m+1; x\right\} = 2^m\{1+\sqrt{1-x}\}^{-m},$$

a result which can be deduced by elementary methods from the difference equation

$$A_{2(m+1)} \pm 2\tan\beta A_{2m} - A_{2(m-1)} = 0,$$

and verified from corresponding differential equation for $F(m/2, m+1/2; m+1; x)$.

Substituting for β gives finally, apart from the sign,

$$A_{2m} = 2\sqrt{K^2-1}\{|K| - \sqrt{K^2-1}\}^m,$$

where K depends only on the voltage ratio, frequency ratio r of the oscillation and signal, and Q-factor of the oscillator circuit.

Buchanan's conclusions can now be simplified and given more precisely:

(d) The amplitude of A_{2m} is determined by r only. It increases from zero, as r is zero, to a maximum and back to zero again the locking point. The maximum is given when

$$K = m/\sqrt{m^2-1}.$$

A_2, on the other hand, decreases monotonically from unity to zero at the locking point.

(e) For $m \geqq 1$, the ratio $A_{2m}/A_{2(m+1)}$ is equal to $|k| - \sqrt{(k^2-1)} = \lambda$ say.

(f) If $k > \sqrt{5}/2$, A_2 is the largest component; $A_2 = A_0$ when $k = \sqrt{5}/2$; for smaller K, A_0 is largest.

(g) The sum of the squares of A_{2m} can easily be found to equal 1. The sum of the squares of all but the first two components equals

$$2\sqrt{K^2-1}\,\lambda^3,$$

the amplitude of A_6, which is a maximum for $K = \frac{3}{4}\;2 = 1.06065\cdots$, when its value is $\frac{1}{4}$.

Alfred G. Simms
Siemans Bros. and Co., Ltd.,
Woolwich
London, S.E. 18,
England

---

* Received by the Institute, December 6, 1952.

[1] T. J. Buchanan, "The frequency spectrum of a pulled oscillator," Proc. I.R.E., vol. 40, pp. 958–961; August, 1952.

A Note on the Circular Dielectric-Disk Antenna*

The circular dielectric-disk antenna is a surface-wave antenna similar to the annular corrugated-surface antenna.[1] It is easy to construct, has relatively high gain, and has good radiation pattern characteristics.

A sketch of the antenna, lying in a large ground plane, appears in Fig. 1. It consists of a circular dielectric disk tapered uniformly in thickness from the center to the edge. The disk is excited from beneath the ground plane by the extended center conductor of a coaxial line.

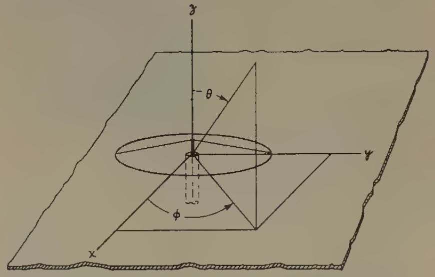


Fig. 1—Sketch of the circular dielectric-disk antenna, mounted in a large ground plane.

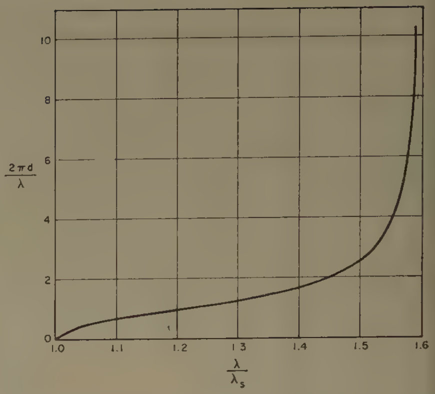


Fig. 2—Normalized surface-wave wavelength, λ/λ_s of a dielectric disk as a function of normalized disk thickness, $2\pi d/\lambda$, for $E = 2.48$.

The surface-wave fields existing in the dielectric have components of electric field in the z and ρ directions, while the magnetic field is in the ϕ-direction coaxial with the z-axis. Only the lowest-order surface-wave mode can exist in the disk as long as its thickness is not greater than $\lambda/4\sqrt{\epsilon-1}$, where λ is the free-space wavelength and ϵ is the relative dielectric constant of the disk. The theoretical surface-wave wavelength λ_s of this lowest-order mode, in a disk of uniform thickness and at radii greater than a quarter wavelength, is plotted in Fig. 2.

The far-zone field has only E_θ and H_ϕ components. It is independent of ϕ, and by proper choice of the phase shift of the surface wave it can be made to have its maximum intensity in the plane $z=0$. The theoretical pattern of the disk of uniform thickness that has the tangential surface electric field, $E_\rho \alpha H_1^{(2)}\, 2\pi\lambda_s/\rho$, is the same as that of the annular corrugated-surface antenna,[1] and has rather large minor lobes. The theoretical patterns of the dielectric disks with varying thickness have proved too difficult to compute. However, it has been found experimentally from trials on a number of configurations that disks tapered uniformly from the center to the edge have the highest gain and lowest side-lobe level. In Fig. 3 the measured radiation pattern of a typical tapered polystyrene disk antenna 30.5 cm in diameter, 0.64 cm thick at the center, and operating at a wavelength of 3.53 cm is compared with the theoretical pattern of a short electric dipole. The directive gain of the disk is 9.9 db compared with the 4.77-db directive gain of the dipole.

E. M. T. Jones
R. A. Folsom, Jr.
Stanford Research Institute
Stanford, Calif.

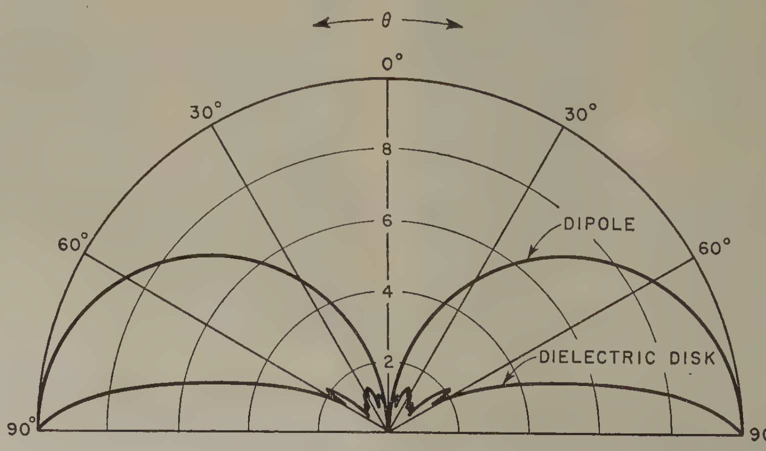


Fig. 3—Measured radiation pattern of a typical dielectric-disk antenna in a large ground plane compared with the theoretical pattern of a short electric dipole in a large ground plane.

---

* Received by the Institute, December 1, 1952. The research reported in this note was done under the auspices of Signal Corps Contract No. DA36-039-sc-5503.

[1] E. M. T. Jones, "An annular corrugated-surface antenna," Proc. I.R.E., vol. 40, pp. 721–725; June, 1952.

Correspondence

Inverted Magnetron*

In his interesting paper[1] on the inverted magnetron, Hull stated that, regarding electron efficiency, the "planar magnetron" is equivalent to the conventional magnetron oscillator; his experimental inverted magnetron approximates a planar magnetron furnishing 300 watts cw at an over-all efficiency of between 30 and 51 per cent.

I would like to mention here that I discussed the problems of the planar magnetron oscillator some years ago in several publications.[2,3,4,5] Such an oscillator was realized in close approximation by a single-cavity interdigital magnetron[6] with 50 segments and a large surface cathode (diameter of cathode, 17 mm; segment-to-cathode distance, 1.5 mm), as shown by Fig. 1 as in one of the publications.[4] Patents[7,8] exist covering the design of large-surface cathodes; the patent referred to in footnote 8 relates to a block-type slotted multicavity magnetron with a large surface cathode (Figs. 2 and 3).

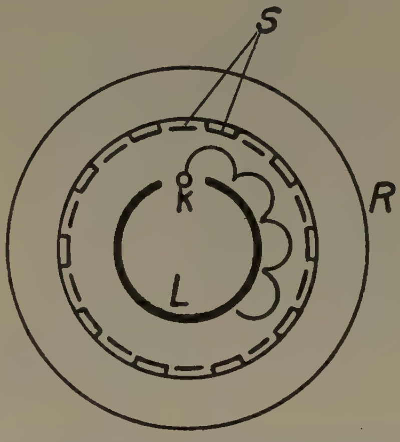


Fig. 1—Single-cavity interdigital magnetron with large number of segments and guide electrode (experimental approximation of a planar magnetron).[4]

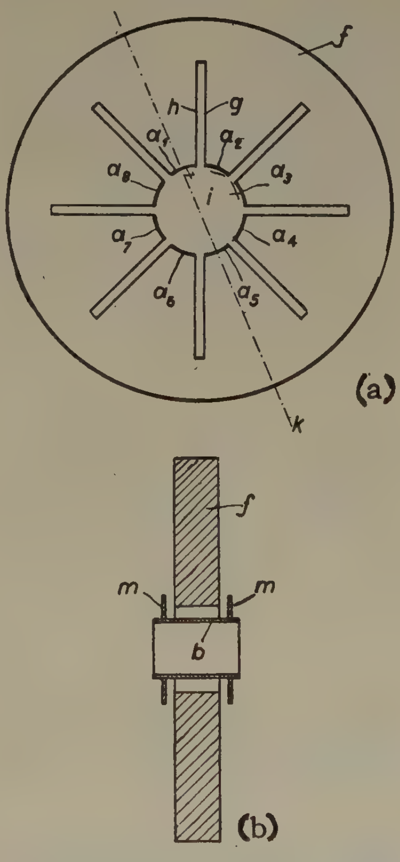


Fig. 2 (a) and (b)—Block-type slotted multicavity magnetron with large-surface cathode (Swiss patent 215,600, filed August 12, 1938).

As Hull pointed out, it is not the number of segments which is important regarding efficiency but rather the ratio *d/s* of the segment-to-cathode distance to the distance between segment centers. I, too, investigated this relation theoretically.[4,5] The knowledge so obtained formed the basis of another patent.[9] Furthermore, I would like to mention that the inverted magnetron was discussed in Switzerland too, not in view of an increase of power output but for a different reason. Unlike the multicavity magnetron, a single-cavity magnetron induces RF currents in the cathode circuit because of the magnetic RF field encircling the cathode. These currents cause power losses and frequency instability. They do not occur, however, when the cathode is arranged outside the resonator, i.e., in an inverted magnetron. The realization of this latter type seemed to be rather difficult at that time and was therefore not undertaken. This decision was made easier by the fact that other methods had been developed to prevent the induction of RF currents in the cathode circuit. A plurality of cavities along a common axis is arranged in such a manner that the sum of the RF magnetic fields is zero,[10] or a helical cathode of a certain minimum length[11] is provided. The usefulness of the latter arrangement is proved by experimental results: 400 watts cw at a frequency of 2,400 mc with an over-all efficiency of 69 per cent, produced by a glass envelope magnetron whose resonator is cooled only by radiation.

I am glad to learn from the paper of Hull that the inverted magnetron has now been realized. Obviously, his magnetron is a further support for the theory of the planar magnetron.

F. Ludi
Brown, Boveri and Cie.
Baden, Switzerland

---

* Received by the Institute November 20, 1952.

[1] J. F. Hull, "Inverted magnetron," Proc. I.R.E., vol. 40, pp. 1038–1041; September, 1952.

[2] F. Fischer and F. Ludi, "Die Posthumus-Schwingungen im Magnetron," *Bull. schweiz. elektrotech. Ver.*, p. 277; 1937.

[3] F. Ludi, "Zur Theorie der geschlitzten Magnetfeldrohre," *Helv. Phys. Acta*, vol. XVI, p. 59; 1943.

[4] *Ibid.*, "Zur Theorie des Magnetfeldgenerators für Mikrowellen," *Helv. Phys. Acta*, vol. XIX, p. 3; 1946.

[5] *Ibid.*, "Der Turbator ein 'Single-Cavity' Magnetron," Marconi Kongress, Verlag Tipografia del Senato, Roma; September 28–October 5, 1947.

[6] U. S. Patent (Turbator) 2.579593, first application, Switzerland; February 9, 1942.

[7] Swiss Patent 200826, first application, Germany; July 25, 1937.

[8] Swiss Patent 215600, first application, Switzerland; August 12, 1938.

[9] U. S. Patent 2.597.506, first application, Switzerland; November 17, 1944.

[10] U. S. Patent 2.607.905, first application, Switzerland; August 16, 1947.

[11] U. S. Patent 2,579.630, first application, Switzerland; July 30, 1947.

Resistive Bidirectional Coupler*

It is of interest to examine the circuit of Fig. 1 and appreciate its equivalence to a bidirectional coupler. The circuit consists of two series resistors (R_s) to monitor the line current and a voltage divider (R_1/R_1+R_2) which provides a signal proportional to the line voltage. When inserted between a load impedance (Z_L) and a power source, the network provides the two voltages E_A and E_B which are proportional to the reflected and incident waves, using the nomenclature of transmission line theory. All of the popular ideas of transmission lines can be applied, and the circuit can be used for impedance or power measurement in a manner analogous to that of bidirectional couplers.

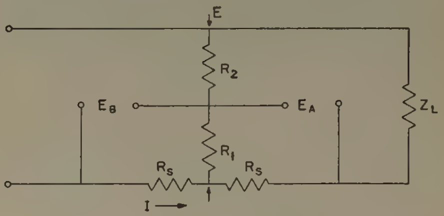


Fig. 1—Coupler circuit diagram.

When the coupler is introduced in the transmission system the current flowing is "*I*" and the voltage is "*E*." It is assumed that the losses in the coupler can be made negligibly small, especially if vacuum tube amplifiers are available for the measurement of the voltages E_A and E_B. Also, it is assumed that the shunt path (R_1+R_2) diverts a negligible amount of current from the load (Z_L).

The reflected voltage is (E_A)

$$E_A = \frac{R_1}{R_1 + R_2} E - IR_s,$$

and the incident voltage (E_B) is

$$E_B = \frac{R_1}{R_1 + R_2} E + IR_s.$$

Since the current flowing is closely

$$I = E/Z_L,$$

the above equations can be simplified to

$$E_A = E\left(\frac{R_1}{R_1 + R_2} - \frac{R_s}{Z_L}\right),$$

and

$$E_B = E\left(\frac{R_1}{R_1 + R_2} + \frac{R_s}{Z_L}\right).$$

The reflected wave (E_A) can be seen to be the error voltage of the bridge formed by arms R_2, R_1, R_s and Z_L and will become zero for the purely resistive termination "R_0" if

$$R_0 = \frac{R_1 + R_2}{R_1} \cdot R_s.$$

This defines the characteristic resistance of the coupler, and allows the basic voltage equations to be simplified to

---

* Original manuscript received by the Institute, November 4, 1952.

[1] B. Parzen, "Impedance measurements with directional couplers and supplementary voltage probe," Proc. I.R.E., vol. 37, pp. 1208–1211; October 1949.

Correspondence

$$E_A = ER_s\left(\frac{1}{R_0} - \frac{1}{Z_L}\right),$$

and

$$E_B = ER_s\left(\frac{1}{R_0} + \frac{1}{Z_L}\right).$$

Dividing the two equations yields

$$E_A/E_B = \frac{Z_L - R_0}{Z_L + R_0},$$

familiar reflection coefficient expression. As a less useful alternative, the voltage standing wave ratio (vswr) for the load is

$$\text{vswr} = \frac{1 + |E_A/E_B|}{1 - |E_A/E_B|}.$$

A vector diagram for the network is shown in Fig. 2 in which the angle "θ" is that associated with the impedance, or it is the angle between the voltage and current in the transmission line. By applying the law of cosines, the following equations result:

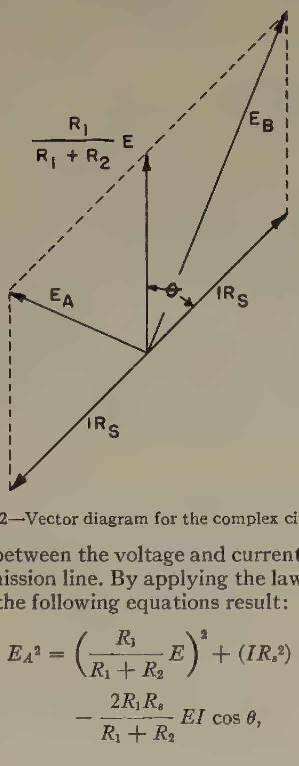


Fig. 2—Vector diagram for the complex circuit.

$$E_A^2 = \left(\frac{R_1}{R_1 + R_2} E\right)^2 + (IR_s^2) - \frac{2R_1R_s}{R_1 + R_2} EI \cos\theta,$$

and

$$E_B^2 = \left(\frac{R_1}{R_1 + R_2} E\right)^2 + (IR_s)^2 + \frac{2R_1R_s}{R_1 + R_2} EI \cos\theta.$$

The difference of the squares is

$$E_B^2 - E_A^2 = kEI \cos\theta$$

where

$$(k = 4R_1R_s/R_1 + R_2),$$

and is a measure of the power dissipated in the load. This useful feature of the circuit has been employed in a number of wattmeter circuits,[2,3,4] which use either thermocouples or squaring amplifiers to obtain E_B^2 and E_A^2 and then subtract the outputs.

Depending on the convenience of the measurement, there are a number of methods for determining the angle θ that are apparent from Fig. 2.

As a conclusion, it appears that the resistive "*T*" network shown exhibits all of the properties and characteristics of a transmission line reflectometer type bidirectional coupler. This equivalence, in addition to generalizing directional coupler theory, has provided a useful wattmeter circuit.

Louis Rosenthal
Department of Electrical Engineering
Rutgers University
New Brunswick, N. J.

---

[2] C. W. Clapp and F. A. Firestone, "The acoustic wattmeter an instrument for measuring sound energy flow," *Jour. Acous. Soc. Amer.*, vol. 13, pp. 124–136; October 1941.

[3] L. R. Malling, "Electronic wattmeter," *Electronics*, vol. 18, pp. 133–135; November, 1945.

[4] J. D. Ryder and M. S. McVay, "A thermocouple audio-frequency wattmeter," Presented at National Electronics Conference, Chicago, Ill.; October, 1952.

A Simple Proof of the Formula for the Relative Accuracy of a Noise Power Measurement with a Quadratic Detector*

We give here a simple proof[1] that the relative accuracy of a single noise power measurement with the help of a quadratic detector is $(2B\tau)^{-1/2}$, where B is the bandwidth of the noise band and τ the time constant of the indicating instrument, and indicate conditions in which this result is valid.

Consider a quadratic measuring instrument through which a noise current $I(t)$ is flowing. Let a current pulse $I(u)$ of duration du, which is applied at the instant u, still give a response,

$$I^2(u)f(t-u)du$$

at the later instant t; $f(t-u)$ is the "normalized" response function of the instrument, defined so that $f(t-u)=1$ for $(t-u)=0$. The response $A(t)$ of the instrument at the instant t, due to the noise current $I(u)$, which has been applied since $u=-\infty$, is

$$A(t) = \int_{-\infty}^{t} I^2(u)f(t-u)du = \int_0^\infty I^2(t-v)f(v)dv. \tag{1}$$

$\bar{A}$ is the average reading[2] of the instrument and $\sqrt{\overline{(A-\bar{A})^2}}/\bar{A}$ is the relative accuracy of a single measurement.

$$\bar{A} = \int_0^\infty \overline{I^2(t-v)}f(v)dv = \overline{I^2}\int_0^\infty f(v)dv \tag{1a}$$

$$\overline{(A-\bar{A})^2} = \bar{A}^2 - (\bar{A})^2 = \int_0^\infty\int_0^\infty [\overline{I^2(t-v_1)I^2(t-v_2)} - (\overline{I^2})^2]f(v_1)f(v_2)dv_1dv_2. \tag{1b}$$

In order to calculate the value of the integrand, we write $I(t+s)$ as

$$I(t+s) = c(s)I(t) + Z(s), \tag{2}$$

where $Z(s)$ is independent of $I(t)$ and $c(s)$ is the autocorrelation coefficient of $I(t)$, which is defined as

$$c(s) = \overline{I(t)I(t+s)}/\overline{I^2}. \tag{2a}$$

As $\overline{I^2(t+s)} = \overline{I^2(t)}$, we have

$$\overline{I^2(t+s)} = \overline{I^2(t)} = c^2(s)\overline{I^2(t)} + \overline{Z^2(s)}, \text{ or}$$
$$\overline{Z^2(s)} = \overline{I^2(t)}[1 - c^2(s)] \tag{3}$$

and, because $\bar{I}^4 = 3(\bar{I}^2)^2$ for any fluctuating quantity having a normal distribution, we have, according to (2) and (3),

$$[\overline{I^2(t)I^2(t+s)} - (\overline{I^2})^2] = c^2(s)\overline{I^4} + \overline{I^2}\cdot\overline{Z^2} - (\overline{I^2})^2 = 2c^2(s)(\overline{I^2})^2. \tag{4}$$

We obtain by substitution into (*1b*)

$$\alpha = \overline{(A-\bar{A})^2}/(\bar{A})^2 = 4\int_0^\infty c^2(s)ds\cdot\int_0^\infty f^2(v_1)dv_1 \Big/ \left[\int_0^\infty f(v_1)dv_1\right]^2 \tag{5}$$

if it may be assumed that the time constant of the indicating instrument is so large that $f(v_1+s) \simeq f(v_1)$ for all values of s for which $c(s)$ has an appreciable value; in the calculation, $s=(v_1-v_2)$ is introduced as a new variable and account taken of the fact $c(-s)=c(s)$ (compare, for example, (*8b*)).

We now assume that the instrument has a response function,

$$f(v) = e^{-v/\tau}, \tag{6}$$

where τ is the time constant of the instrument. This occurs, for example, if the detector+indicating instrument consists of hot-wire ammeter, if the quadratic detector is coupled to the indicating instrument by means of a low-pass RC filter or indicating instrument a heavily damped galvanometer. Substituting (6) and (5), we obtain

$$\alpha = (2/\tau)\int_0^\infty c^2(s)ds. \tag{7}$$

The autocorrelation coefficient $c(s)$ may be calculated from the spectral distribution of the noise. Let $\overline{i^2}$ be the mean-square value of the Fourier coefficient of $I(t)$, so that

$$\overline{i^2} = w(f)df,$$

where $w(f)$ is the "spectral distribution" of $I(t)$; then, according to the Wiener-Khinchine theorem,

$$w(f) = 4\int_0^\infty \overline{I(t)I(t+s)} \cos\omega s ds. \tag{8}$$

If $w(f)$ is known, we have from (8) by inversion

$$\overline{I(t)I(t+s)} \doteq \int_0^\infty w(f) \cos\omega s df. \tag{8a}$$

We have a narrow square noise band of cente frequency f_0 and width B, so that $w(f)=w$ for $(f_0-\frac{1}{2}B) \leqq f \leqq (f_0+\frac{1}{2}B)$ and $w(f)=0$ outside that interval,

$$\overline{I(t)I(t+s)} = w_0B\cos 2\pi f_0s \sin(\pi Bs)/(\pi Bs) = w_0Bc(s). \tag{8b}$$

Substituting into (7), we have

$$\alpha = 1/(2B\tau). \tag{9}$$

---

* Received by the Institute, December 23, 1952.

[1] Compare with S. O. Rice. "Mathematical analysis of random noise," *Bell Sys. Tech. Jour.*, vol. 23, p. 282; 1944, and vol. 24, p. 46; 1945.

[2] — denotes an average value taken over an ensemble of identical systems.

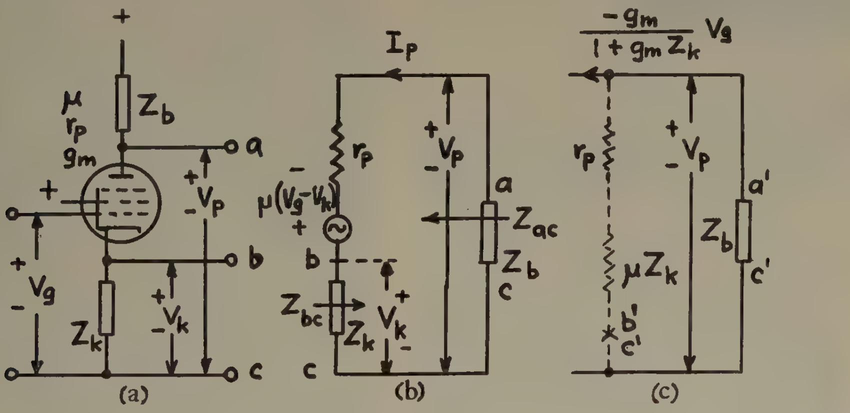
Correspondence

The relative accuracy of the noise measurement for a single reading under the above conditions is therefore $(2B_T)^{-1/2}$, as had to be proved. The calculation for other noise bands and for other response functions can be carried out with the help of (5). For the same noise band and a critically damped galvanometer with time constant τ the relative accuracy is found to be $(4B_T)^{-1/2}$.

A. van der Ziel
Dept. of Electrical Engineering
Institute of Technology,
University of Minnesota
Minneapolis 14, Minn.

Degenerative Pentode Equivalent Circuit*

The pentode circuit shown in Fig. 1(a) is used in modern feedback video and pulse applications, essentially when an out-of-phase component V_k to the plate voltage V_p is needed, or when increased input impedance is desired (cathode feedback action with Z_k resistive, no output lead from the cathode). The various bias arrangements possible for this circuit have been omitted or reasons of simplicity.



(a) (b) (c)

Fig. 1

Fig. 1(b) shows the conventional "constant voltage" type of equivalent circuit, from which we read the equation.[1,2]

$$V_p = \frac{-Z_b}{Z_b + r_p + Z_k}\mu(V_g - V_k),$$

where $V_k = -Z_k V_p / Z_b$. Since $\mu \gg 1$, we obtain the amplification

$$A = \frac{V_p}{V_g} \doteq \frac{-\mu Z_b}{Z_b + r_p + \mu Z_k} \cdot \qquad (1)$$

Multiplying numerator and denominator by $(r_p + \mu Z_k)$, and using the symbol // to mean "in parallel with," we obtain the expression

$$V_p \doteq \frac{-g_m}{1 + g_m Z_k} V_g [Z_b // (r_p + \mu Z_k)], \qquad (2)$$

which describes the combination of circuit elements shown in the "constant-current" type circuit, Fig. 1(c), including all dotted lines. The current $-g_m V_g/(1+g_m Z_k)$ produces the voltage V_p when passing through the shown network.

In many applications $(r_p + \mu Z_k) \gg Z_b$, and (2) then takes the simple form

$$A \doteq \frac{-g_m}{1 + g_m Z_k} Z_b, \qquad (3)$$

which for $Z_k = 0$ simplifies to the well-known pentode formula $A = -g_m Z_b$. The equivalent circuit described by (3) is now the one shown by the full lines in Fig. 1(c).

When high g_m (power) pentodes are used, and Z_k is of the order of a few thousand ohms, the further approximation $g_m Z_k \gg 1$ is obtained, yielding the simple expression

$$A \doteq \frac{-Z_b}{Z_k} \cdot \qquad (4)$$

Even if $g_m Z_k > 1$, but not $\gg 1$, so that the resulting percentage error is considerable, (4) is useful as a thumb rule for quick estimation of absolute gain and phase shift in a degenerative pentode amplifier.

Extending the discussion of the equivalent circuit to include output impedances from plate and cathode, Z_{ac}, respectively Z_{bc}, it is realized that at least in video applications Z_b is very much smaller than the other impedances involved, so that

$$Z_{ac} \doteq Z_b. \qquad (5)$$

The output impedance Z_{bc} of triodes and pentodes with a cathode impedance Z_k is well known from the approximate formula generally given in technical texts

$$Z_{bc} \doteq \frac{Z_k}{1 + g_m Z_k}, \text{ or } Z_{bc} \doteq \frac{Z_k(r_p + Z_b)}{r_p + Z_b + \mu Z_k} \cdot \qquad (6)$$

The second form of the equation here describes the conditions when the plate resistance has been extended by an impedance Z_b, inserted in the plate circuit. It is of interest to note that, without circuit analysis, purely as a support for the memory, this formula can be read off from the diagram in Fig. 1(c) as follows: One may reason that looking in through the impedance μZ_k rather than the neglected and therefore nonexistent impedance Z_k (marked by the cross $b'c'$ in Fig. 1(c)), the combination impedance is presented on a μ times too high impedance level. The proper expression is therefore obtained by dividing the combination impedance by μ. Accordingly, it is seen that

$$Z_{bc} \doteq \frac{1}{\mu}[\mu Z_k // (r_p + Z_b)] \qquad (7)$$

is identical with (6).

The circuit in Fig. 1(b) was used for derivation only. The circuit in Fig. 1(c) is useful in applications where additional shunting circuit elements appear, and is free from approximations, except $\mu \gg 1$, if the dotted network is included, and if the simple idealized electrode connections shown in Fig. 1(a) are maintained. In practical circuits, capacitances and losses may occur, which cannot be included in the plate and cathode impedances shown, or electrode connections may be used that jeopardize the basic pentode operation. Thus screen grid circuits, which have not been considered in the above analysis, may be formed, yielding triode rather than pentode characteristics. Both the equivalent circuits shown, Fig. 1(b) and (c), would be modified to fit the requirements of more complete circuits.

Harry Stockman
Stockman Electronics Research Co.
Waltham, Mass.

---

* Original manuscript received by the Institute, September 25, 1952.

[1] Cruft Lab. War Training Staff, "Electronic Circuits and Tubes," McGraw-Hill Book Co., Inc., New York, N. Y., pp. 410–421, 1947.

M.I.T. Staff, "Applied Electronics," John Wiley and Sons, New York, N. Y., pp. 532–533, 1943.

More on the RC Oscillator*

Since the note by Davidson[1] is likely to be of considerable interest to those involved in the design of RC oscillators, the following remarks are offered:

It is well known in the design of conventional RC oscillators that a sufficient condition to be imposed on the frequency-determining network when $R_1 = 0$ (Fig. 1) is $R_2C_2 = R_3C_3$ for optimum tracking since

$$\omega_0^2 = \frac{1}{R_2C_2R_3C_3\left(1 + \frac{R_A}{R_2}\right)} \cdot$$

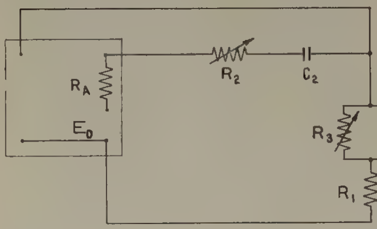


Fig. 1

However, it should be noted that when $R_1 = RA/2$ it is necessary to make $R_2 = R_3$ and $C_2 = C_3$ for $\omega_0 = 1/R_2C_2$. Imposing the less restricted condition $R_2C_2 = R_3C_3$ leads to the following frequency of oscillation:

$$\omega_0^2 = \frac{1}{R_2^2C_2^2}\left[\frac{2R_2R_3 + R_2R_A}{2R_2R_3 + R_A(2R_3 - R_2)}\right].$$

William J. Wray, Jr.
Associate Research Engineer
Burroughs Adding Machine Co
511 North Broad St.
Philadelphia, Pa.

---

* Received by the Institute, October 7, 1952.

[1] J. A. Davidson, "A precision decade oscillator," Proc. I.R.E., vol. 401, no. 9; Sept. 1952.

Institute News and Radio Notes

On page 674 of the May 1953 issue of PROCEEDINGS a photograph of John R. Pierce, Bell Telephone Laboratories, was inadvertently used instead of a photograph of John A. Pierce, Harvard University. Mr. John A. Pierce (below) was the recipient of the 1953 Morris Liebmann Memorial Prize.

JOHN A. PIERCE

Morris Liebmann Memorial Prize—1953

"For his pioneering and sustained outstanding contributions to radio navigation, and his related fundamental studies of radio wave propagations."

Calendar of COMING EVENTS

- **High Frequency Communication Symposium, IRE Professional Group on Communications Systems, Long Lines Auditorium, 32 Avenue of the Americas, New York, N. Y., June 11–12**
- Symposium on Microwave Optics, McGill University, Montreal Canada, June 22–24
- American Society for Engineering Education Convention, University of Florida, Gainesville, Fla., June 22–26
- National American Radio Relay League Convention, Shamrock Hotel, Houston, Texas, July 10–12
- **IRE-ONR-Univ. of Calif. Symposium on Statistical Methods in Communication Engineering, Berkeley, Calif., August 17–18**
- **IRE Western Convention and Electronic Show, Civic Auditorium, San Francisco, Calif., August 19–21**
- International Sight and Sound Exposition and Audio Fair, Chicago, Ill., September 1–3

TECHNICAL COMMITTEE NOTES

The **Standards** Committee met during the National Convention at the Waldorf-Astoria on March 26 under the Chairmanship of A. G. Jensen. Chairman Jensen explained, for the benefit of the incoming chairmen and vice-chairmen, that the convention meeting was necessarily brief; the primary purpose was to afford them the opportunity of meeting the Standards Co-ordinator and the members of the Standards committee. The following new chairmen were introduced: K. E. Anspach, Symbols Committee; H. F. Burkhard, Facsimile Committee; W. P. Mason, Piezoelectric Crystals Committee; and J. Z. Millar, Annual Review Committee. It was noted that P. J. Herbst who is to assume the Chairmanship of the Radio Transmitters Committee was unable to attend. Chairman Jensen emphasized the importance of the participation of vice-chairmen in committee activities. They were urged to acquaint themselves with the work in progress within the Standards Committee and to represent their committees at Standards Committee meetings whenever the chairmen were unable to attend. Members were given a review of the number of standards published during 1952, those which are to appear in the PROCEEDINGS within the next few months, and the material presently on Grand Tour. The actual progressing of standards including the Grand Tour procedure was described. Chairman Jensen referred to the liaison work done by the two vice-chairmen, Ernst Weber and M. W. Baldwin, Jr., who arrange for proper co-ordination between the various committees in the preparation of standards, and to the services of the Technical Secretary (the third vice-chairman) and his very competent staff. He also advised the committee that Headquarters expects to circulate the third edition of the Master Index of Definitions to all chairmen within the month. The Standards Co-ordinator, S. L. Bailey, was then introduced. Mr. Bailey acknowledged the introduction by saying he preferred the term "liaison" to "co-ordinator"; that he is the medium through which information flows back and forth between the Executive Committee, Board of Directors and the Standards Committee. He drew attention to several items recently discussed by the Executive Committee and stressed the necessity for pointing up in the minutes any matters requiring Executive Committee action.

The **Antennas and Waveguides** Committee convened on March 11 under the Chairmanship of D. C. Ports. The committee was acquainted with the action taken to date by the Standards Committee on the list of Definitions of Waveguide Terms (51 IRE 2. PS1). Discussion ensued on the revisions suggested to the terms: Artificial Line, Axial Ratio, Balanced Line, Balanced Potentials, Characteristic Impedance (of a Rectangular Waveguide), Characteristic Impedance (of a Circular Waveguide) and Dielectric Waveguide. An ad hoc committee was set up to formulate a satisfactory definition for Direction of Propagation. The remainder of the meeting was devoted to further consideration of the list of component definitions.

The **Electroacoustics** Committee met January 30 under the Chairmanship of W. D. Goodale, Jr. Comments received from P. S. Veneklasen, H. C. Hardy, W. F. Meeker, Vincent Salmon and B. B. Bauer on the draft of the Proposed American Recommended Practice for Loudspeaker Testing, were reviewed in detail. Appropriate revisions were made in the text of the proposed standard which is to be circulated to all members. Chairman Goodale thanked the following people for their efforts on behalf of the committee: H. C. Hardy for his article in the Annual Review; H. F. Olson for writing Section 10 of the Proposed American Recommended Practice for Loudspeaker Testing; and E. S. Seeley for his contributions to the written draft of the above standard.

On March 13 the **Electron Devices** Committee convened under the Chairmanship of G. D. O'Neill. R. B. Janes submitted the proposed revised Phototube Definitions. It was emphasized that these were new definitions, not merely a revision of the 1938 Standards. After considerable discussion and some revisions, it was moved and seconded that they be accepted. Dr. Janes reported that a rough draft of the Methods of Test for Phototubes was ready. Dr. Janes also reported that a new subcommittee will be

(*Technical Committee Notes Cont.*)

formed to re-define terminology for Cathode Ray Tube Electrodes.

The **Facsimile** Committee met on March 6 under the Chairmanship of R. J. Wise. An inquiry concerning recent developments in the facsimile art, particularly recording method and apparatus was read and discussed. Copies of several test charts used by Western Union were distributed by K. McConnell. Discussion ensued on what is considered essential in a test chart and whether or not there should be two charts, one for laboratory use and another for field tests. With reference to Precise Definition Measurements, I. H. Franzel described a method devised by R. G. Brown for measuring fidelity of reproduction in the graphic arts and suggested that it might be adopted for precise measurements of definition in facsimile. The method appears to have considerable merit. In accordance with the program outlined at the February 6 meeting, the committee proceeded to list the requirements for a proposed test chart for the industry. These were divided into two groups. It was agreed members would endeavor to prepare a mock-up or sketch of a chart incorporating all items for discussion at the April 10 meeting.

On February 27 the **Radio Transmitters** Committee convened under the Chairmanship of M. R. Briggs. H. R. Butler reviewed the work done by his subcommittee 15.2 on the Proposed Standards on Methods of Testing Telegraph Transmitters. The final draft is to be considered by the subcommittee at its next meeting, and if adopted will be ready for review by the main committee in April. Chairman Briggs read a letter from J. B. Heffelfinger wherein he stated that his subcommittee 15.3 plans to compile and edit the rough work sheets from various members on the Proposed Methods of Testing Double Sideband Transmitters. P. J. Herbst stated that his group, Subcommittee 15.5, is to meet shortly to go over the final draft of the Proposed Standards on Methods of Testing Television Transmitters. If no extensive revisions are needed, the draft will be ready for submittal to the main committee sometime in April. The committee then turned its attention to the consideration of the Proposed Standards on Pulses: Methods of Measurement of Pulse Quantities, Part I. Harold Goldberg reported that no adverse comments had been received. Mr. Herbst stated that his associates had given the draft careful consideration and that there was unanimity of opinion on the excellence of the work. However, informal comments had been made to the effect that an introductory paragraph or foreword might be included indicating that this is an initial effort and the scope is necessarily broad. The draft was given approval by the main committee and it will be sent to the Measurements Co-ordinator for the Grand Tour.

On March 13 the **Video Techniques** Committee convened under the Chairmanship of W. J. Poch. The proposed standard on the Methods of Measurement of Aspect Ratio and Geometric Distortion was discussed. This report had been circulated to the membership by A. J. Baracket, chairman of the Subcommittee on Video Systems and Components. A thorough review of the report resulted in a few minor corrections of the text. The over-all impression created was that a very commendable job had been done and a valuable contribution to the television industry is being made. After final consideration at the next meeting of the Committee, it may be possible to recommend this standard for consideration by the Standards Committee. Several new definitions are needed for the proposed Method of Measurement of Aspect Ratio and Geometric Distortion. After considerable discussion the definitions Space Pattern and Time Pattern were tentatively approved. Some time was spent discussing the definitions tentatively approved at the last meeting.

* * *

NATIONAL ARRL CONVENTION

The Houston Amateur Radio Club will be host to the seventh annual national American Radio Relay League convention to be held at the Shamrock Hotel, Houston, Texas, on July 10–12. About 3,000 "hams" and their wives are expected to attend.

The technical program will cover from the latest on transistors to ham television and teletype. Major manufacturers will exhibit all types of communications gear.

A gala entertainment program has been planned for the ladies as well as the men. A preconvention party will be held the evening of July 9, preceding the official opening.

All persons interested in communications and allied subjects are invited. For information and registration blanks contact: Convention Committee, Box 907, Houston, Texas.

Professional Group News

AIRBORNE ELECTRONICS

The Dayton Chapter of the Professional Group on Airborne Electronics met recently at the Engineer's Club with Maurice Jacobs as Chairman. Herbert Koppel, W. L. Maxson Corp., spoke on "Design Techniques of a Digital Computer." He demonstrated a digital computer named *Nim* built by engineers of his company which the audience was invited to attempt to "beat." Slides were displayed outlining principles of the computer.

ANTENNAS AND PROPAGATION

The new Los Angeles Chapter of the Professional Group on Antennas and Propagation held an organizational meeting in April following the Technical Session of the Los Angeles Section. Members elected the following officers from the list prepared by the Nominating Committee: M. J. Ehrlich, Chairman; R. S. Wehner, Vice-Chairman, both of Research and Development Labs, Hughes Aircraft Co.; and Robert Krausz, Aerophysics Laboratory, North American Aviation, Inc., Secretary. J. V. N. Granger of the Stanford Research Institute spoke generally about "Aircraft Antenna Design Limitations." His summary served to emphasize the large strides which have been made in acquiring a general understanding of problems associated with aircraft communication and navigation antennas as compared with the situation in 1944 when the problems were first clearly recognized.

COMMUNICATION SYSTEMS

John Hessel has been elected Chairman of the Professional Group on Communication Systems for the term beginning July 1. Murray Crosby will serve as Vice-Chairman. Members to serve on the Administrative Committee for a three year term were also elected. They are: A. G. Clavier, Federal Telecommunications Laboratories, Inc., Nutley, N. J.; L. M. Craft, Collins Radio Co., Cedar Rapids, Iowa; J. J. Kelley, Bureau of Ships, Navy Department, Washington, D. C.; R. L. Marks, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.; J. Z. Millar, Western Union Telegraph Co., N. Y.; O. G. Villard, Jr., Leland Stanford Junior University, Stanford, Calif.

ELECTRONIC COMPUTERS

The Los Angeles Chapter of the Professional Group on Electronic Computers met recently at UCLA under the Chairmanship of W. F. Gunning. A panel discussion with R. Thorenson was held on switching circuits for magnetic drum memories. Each member of the panel discussed the problems and solutions his group arrived at in solving this general problem.

The Philadelphia Chapter met recently at the Franklin Institute with I. L. Auerbach as Chairman, J. P. Eckert, Jr., director of engineering of Remington Rand, Inc. (Eckert-Mauchly Division), gave a paper entitled "Comparison and Evaluation of Digital Computer Memory Systems."

The Washington Chapter of the Group met recently at the Pepco Auditorium with C. V. L. Smith as Chairman. Inaugural of the newly elected Chapter officers was held. Officers for the coming year are: C. V. L. Smith of the Office of Naval Research, Chairman; D. R. Jacobs of the Jacobs Instrument Company, Vice-Chairman; R. J. Slutz of the National Bureau of Standards, Secretary. A paper entitled "How The UNIVAC Predicted the Elections" was given by H. F. Mitchell, Jr., of Eckert Mauchly Division, Remington Rand Inc., Philadelphia.

At an earlier meeting in the Auditorium of the Potomac Electric Power Co. with C. V. L. Smith as Chairman, the Chapter heard Professor Charles Pulvari, research professor of electrical engineering at the Catholic University of America, give a paper entitled "The Snapping Dipoles of Ferroelectrics as Digital Computer Memory Elements." Professor Pulvari described his experiments in constructing binary memory elements in the form of small condensers, using berium titanate ceramic as dielectric. The problems of storing information in and extracting information from such elements was covered in detail. He also demonstrated how a multielement memory could be constructed, and discussed the switching problems encountered in the read-in and read-out process.

ENGINEERING MANAGEMENT

The Professional Group on Engineering Management has elected the following offi-

Professional Group News

cers to take office July 1. Chairman, General T. C. Rives; Vice-Chairman, C. J. Breitwieser. Administrative Committee members will be: W. J. Barkley, C. J. Breitwieser, R. I. Cole, A. D. Emurian, B. C. Batsel, T. C. Rives, F. W. Schor, John Slattery, and Wilbur Webb.

The Los Angeles Chapter held two meetings recently at the Institute of Air Sciences Building with T. W. Jarmie as Chairman. The earlier one was an organizational meeting during which plans for future meetings were discussed. Speaker was E. M. Glaser, partner in the Edward M. Glaser Associates. His paper was entitled "The Contributions and Limitations of Psychology in Industry." The audience participated in a discussion following the presentation.

The new Washington D. C. Chapter has held several meetings this winter with R. D. Bennett as Chairman. Subjects of the various speakers have included "Professional Management and The Engineer," given by R. C. Rives, Director of Advanced Research Laboratory, General Electric Co., Ithaca, N. Y. for W. R. G. Baker, Vice-President for Electronics, General Electric Co., Syracuse, N. Y. who was unable to attend; "In What Respects Is It Practical to Pre-plan Research," given by B. F. Skinner, Psychological Laboratories of Harvard University, as part of a roundtable discussion led by Allen Schooley, director of National Science Foundation; another roundtable discussion led by Mr. Schooley on "How Administration Can Be Of Service To the Research Scientist," with Doctors Wilder, Small, and Baylis of the National Institute of Health speaking; and "Inventions, Inventors and Management," by R. M. Page, Associate to the Director of Research and Development, Naval Research Laboratory, Washington. Meetings were held in the Department of Interior Auditorium, the Federal Personnel Council, and the Commerce Department Auditorium. At the organizational meeting held last fall J. W. Klotz was temporary Chairman. R. R. Crane, operations research analyst of Melpar, Inc., Alexandria, Va., gave a paper entitled "The Role of Operations Research in Engineering Management." A general discussion followed.

TWO NEW PROFESSIONAL GROUPS ESTABLISHED

The establishment of two new professional groups recommended by the Professional Group Committee was approved by the Board of Directors at their March meeting. They will be named the Professional Group on Ultrasonic Engineering and the Professional Group on Component Parts.

Acting chairmen have called meetings to formulate Constitutions which must be submitted for the approval of the Executive Committee within the time specified in the Bylaws of the Institute.

Inquiries to Headquarters are invited from those interested.

MEDICAL ELECTRONICS

The Buffalo-Niagara chapter of the Professional Group on Medical Electronics met recently at the Chronic Disease Research Institute with Wilson Greatbatch as Chairman. Speaker of the evening was Charles Bishop, biochemist and assistant laboratory director of the Chronic Disease Institute. He told about the work of the Institute, discussing, in particular, the use of "tagged" molecules in medical research.

It is the purpose of the Professional Group on Medical Electronics to make the combined electronic engineering experience of its members available as a free advisory service to the medical profession. In the Group are engineers and physicists experienced in the fields of cryogenic physics, nuclear physics, blood pressure recording, electro-encephalography, electro-cardiography, electronic plethysmography, intracardiac recording, high-vacuum physics and medical photography. Meetings are open and a cordial invitation is extended especially to medical research workers as well as engineers.

The inaugural meeting of the San Francisco Chapter was held last March at the Office of Naval Research. A. J. Morris, promoter of the organization of this new group, acted as temporary chairman. Officers were elected as follows: Chairman: A. J. Morris, Office of Naval Research, San Francisco; Vice-chairman: L. B. Lusted, University of California Hospital; Secretary-treasurer: D. K. Reynolds, Stanford Research Institute. A program committee consisting of the following members was appointed: R. E. Miller, Electronics Research Laboratory, Stanford University; Thomas Jaski, University of California Hospital; and Stanley Turner, University of California. Plans for future activities of the Chapter were discussed, especially participation in the next West Coast IRE Convention.

INDUSTRIAL ELECTRONICS

FCC certification of all industrial R.F. heating equipment (new and old) is required, in accordance with the Commission's Rules and Regulations, Part 18, by June 30, 1953. Large numbers of installations are now causing serious interference to established communication and entertainment radio systems. In the interest of aiding all users of such equipment to comply with the FCC regulations, the IRE Professional Group on Industrial Electronics is desirous of compiling a list of all competent engineers or concerns capable of supplying technical assistance and FCC certification service to the user. Any person or concern who is in a position to supply this type of service may submit their name to Carl E. Smith, secretary, IRE Administrative Committee of the Professional Group on Industrial Electronics, c/o United Broadcasting Company, 5000 Euclid Ave., Cleveland 3, Ohio.

INFORMATION THEORY

The Los Angeles Chapter of the Professional Group on Information Theory have been holding meetings regularly every other month at the Institute for Numerical Analysis, University of California, Los Angeles, with R. B. Conn as Chairman. Papers have been given on the subjects of "Random Noise in Distributed Systems," by R. E. Roberson, member of Autocontrol Section, North American Aviation; "Optimum Demodulation," by F. W. Lehan, section chief of the Electronics Research Section, Jet Propulsion Laboratory, University of California; and "Optimum Linear Prediction Using Discrete Data," by D. B. Duncan and Norman F. Parker, supervisor of Investigations Unit and assistant section chief, respectively, of the Autocontrol Section of the Aerophysics Laboratory, North American Aviation. At a meeting held in conjunction with the Los Angeles Section in the Institute for Aeronautical Sciences Building G. O. Young, member of the technical staff of Hughes Research and Development Laboratories, gave a paper entitled "Output Signal-Plus-Noise Spectra of Nonlinear Amplifiers."

NUCLEAR SCIENCE

The Oak Ridge Chapter of the Professional Group on Nuclear Science was organized in 1952 to serve the interests of the IRE members in that vicinity. Organizer and temporary chairman was D. J. Knowles, who was assisted by W. G. James, E. C. Evans, M. R. Donaldson, Gene Banta, Byron Behr, Odell Eason, T. J. Lewis, R. W. Schede, H. Walchli, R. Affel, and E. Fairstein. The Chapter has been meeting once a month and has been addressed by outside as well as local speakers. Officers recently elected for the coming year are: Chairman, W. J. James; Vice-Chairman, Gene Banta; Secretary-Treasurer, Harold Walchli.

VEHICULAR COMMUNICATIONS

The Los Angeles Chapter of the Professional Group on Vehicular Communications held their first panel discussion recently at the Institute of Air Sciences Building with M. E. Kennedy as Chairman. The discussion was called "Problems Facing Vehicular Communications Systems." The panel consisted of Mr. Ludekins, chief communications engineer, Southern California Edison Co.; Mr. Ravich, communication engineer, Department of Water and Power; W. E. Cole, assistant electrical engineer, Los Angeles County Flood Control District; Fred Crider, communications chief, Los Angeles Police Department; Frank Hardwick, communications engineer, Radio Corporation of America; Robert Stratton, engineer, Federal Communications Commission; and Robert Crabb, moderator of the panel, Radio Communications Service. Topics such as cross modulation, frequency splitting, interference of many types and joint use of the same frequency by taxicab systems were discussed by the panel and the audience. In addition to the above topics the many problems facing expanding systems on crowded channels was also discussed. This type of meeting proved so successful that it is desired to continue having panel discussions in the future.

The Washington Chapter met recently at the Statler Hotel with Waldo Shipman as Chairman. At the election of officers the following were elected for the coming year: Chairman, E. L. White; Vice-Chairman, Merle Floegel; Secretary, Grant Woodside.

Transactions of the IRE Professional Groups

Issues Recently Published

The following issues of TRANSACTIONS are now available from the Institute of Radio Engineers, Inc., 1 East 79 Street, New York 21, N. Y. Prices are indicated below, followed by a listing of the contents of each issue.

Sponsoring Group	Publication	Group Members	IRE Members	Non-Members*
Airborne Electronics	PGAE-7	$0.50	$0.75	$1.50
Audio	Vol. AU-1, No. 2	0.80	1.20	2.40
Broadcast and Television Receivers	PGBTR-2	0.60	0.90	1.80
Electronic Computers	Vol. EC-2, No. 1	0.70	1.05	2.10
Information Theory	PGIT-1	2.25	3.40	6.75
Instrumentation	PGI-1	1.65	2.45	4.95
Microwave Theory and Techniques	Vol. MTT-1, No. 1	1.10	1.65	3.30
Quality Control	PGQC-2	1.30	1.95	3.90

* Public libraries and colleges can purchase copies at IRE Member rates.

PGAE-7, March, 1953

(*Symposium on Electronics and the Airlanes, National Conference on Airborne Electronics, Dayton, Ohio, May 12–14, 1952*)

Vol. AU-1, No. 2, March-April, 1953

Technical Editorial

Electronic Music—Past, Present and Future, *Earl L. Kent*

PGA News

Report of Southwestern IRE Conference and Electronics Show, *B. B. Bauer*
Report of the Secretary-Treasurer, *Marvin Camras*
Report of the Activities of the Tapescript Committee, *A. B. Jacobsen*

Technical Papers

Analysis of a Single-Ended-Push-Pull Audio Amplifier, *Chai Yeh*
Equalization of Magnetic Tape Recorders for Audio and Instrumentation Applications, *Frank Lennert*
Why Fight Grid Current in Class B Modulators?, *J. L. Hollis*
Microphone Sensitivity Conversion Chart, *Leo Rosenman*

PGA Institutional Listings

PGBTR-2, March, 1953

General Color-Receiver Design Considerations, *Charles J. Hirsch and Bernard D. Loughlin*
Connection of UHF and Color Adaptors to UHF Receivers, *Leonard H. Horn*

Vol. EC-2, No. 1, March, 1953

Editorial

Dynamic Circuit Techniques used in SEAC and DYSEAC, *R. D. Elbourn and R. P. Witt*
Symbolic Programming, *Nathaniel Rochester*
Contributors
Institutional Listings

PGIT-1, February, 1953

(*Symposium on Information Theory, London, England, September, 1950*)

Nature, Scope and Terminology of Informa-Theory:
  Communication Theory, Past, Present and Prospective, *D. Gabor*
  Glossary of Physiological Terms, *J. A. V. Bates*
  The Nomenclature of Information Theory, *D. M. MacKay*
A History of the Theory of Information, *E. Colin Cherry*
Communication Theory—Exposition of Fundamentals, *C. E. Shannon*
Communication Theory and Physics, *D. Gabor*
Quantal Aspects of Scientific Information, *D. M. MacKay*
The Statistical Approach to the Analysis of Time-series, *M. S. Bartlett*
General Treatment of the Problem of Coding, *C. E. Shannon*
The Lattice Theory of Information, *C. E. Shannon*
Theory of Radar Information, *P. M. Woodward*
Fluctuations and Theory of Noise, *D. K. C. MacDonald*
Communication Theory and Linguistic Theory, *D. B. Fry*
Hearing, *T. Gold*
The Problem of the Information which the Brain Receives from the Eye, *W. A. H. Rushton*
Information Theory in Psychology, *W. E. Hick*
Possible Features of Brain Function and their Imitation, *W. Grey Walter*
Significance of Information Theory to Neurophysiology, *J. A. V. Bates*
Information, Machines, and Brains, *A. M. Uttley*
Statistics for the Chess Computer and the Factor of Mobility, *Eliot Slater*
Criteria of Prediction and Discrimination, *J. H. Westcott*
Entropy, Time and Information (Introduction to Discussion), *D. M. MacKay*
Discussion
Discussion on Mr. E. C. Cherry's Paper "A History of the Theory of Information"
Discussion on Dr. C. E. Shannon's Papers
Discussion on Dr. D. Gabor's Paper "Communication Theory and Physics"
Discussion on Mr. D. M. MacKay's Paper Quantal Aspects of Scientific Information"
Discussion on Professor M. S. Bartlett's Paper "The Statistical Approach to the Analysis of Time-series"
Discussion on Mr. P. M. Woodward's Paper on "Theory of Radar Information"
Discussion on Dr. D. K. C. MacDonald's Paper "Fluctuations and the Theory of Noise"
Discussion on Dr. T. Gold's Paper on "Hearing"
Discussion on Dr. W. E. Hick's Paper "Information Theory in Psychology"
Discussion on Dr. J. A. V. Bates' Paper "Significance of Information Theory in Neurophysiology"
Discussion on Dr. A. M. Uttley's Paper "Information, Machines and Brains"
Discussion on Dr. E. Slater's Paper on "Statistics for the Chess Computer and the Factor of Mobility"
Discussion on Dr. J. H. Westcott's Paper "Criteria of Prediction and Discrimination"
Discussion on Mr. D. M. MacKay's Paper "Entropy, Time and Information"

PGI-1, May, 1953

(*Data Handling Systems Symposium, IRE Western Convention, Long Beach, Calif., August 27–29, 1952*)

Organization of Data for an Automatic System, *D. V. Savidge*
Problems in the Development of an Automatic Data Handling System at NOTS, *E. E. Green*
Progress in Automatic Data Handling at Lewis Flight Propulsion Laboratory of N.A.C.A., *L. Jaffee*
Automatic Reduction of Wind Tunnel Data, *V. S. Haneman, Rauch, Leite and Cotecchia*
The SADIC, A Precision Analog-Digital Converter, *R. L. Sink and G. M. Slocomb*
E.R.A. Shaft-Position Analog-to-Digital Converter, *G. W. Lund*
A Position Data Measuring System, *A. F. Bowen*
A Binary Outscriber Using Facsimile Paper, *W. H. Ware*
Design Considerations and New Developments in the "Flying Typewriter", *J. J. Wild*
High Speed Printing Equipment, *L. Rosen*
A Complete Telemetry System for the Flight Testing of Aircraft, *F. E. Bryan*
A System for Recording Telemetered Data in Digital Form, *D. J. Simmons*
Multi-Channel FM/FM Telemeter Data Handling System, *C. P. Ballard*

Vol. MTT-1, No. 1, March, 1953

Foreword
A New Chart for the Solution of Transmission Line and Polarization Problems, *Georges Deschamps*
Some Coupled-Wave Theory and Application to Waveguides (Abstract), *S. E. Miller*
Audio Modulation Substitution System for Microwave Attenuation Measurements, *John Korewick*
The Microwave Interferometer for Measuring the Time Displacement of a Projectile Within the Barrel of a Gun (Abstract), *H. C. Hanks, Jr.*
Performance of Ferrites in the Microwave Range (Abstract), *A. G. Fox*
Microstrip—A New Microwave Transmission Technique (Abstract), *H. F. Engelmann*
X-Band Rotary Joint, *H. J. Riblet and R. L. Williston*
Doubly Compensated Tunable Cavity, *T. S. Saad*
Compact Top-Wall Hybrid Junction, *Eugene Hadge*
Duplexing Filter Design at 2000 Mc, *D. R. Crosby*
A Standard Waveguide Spark Gap, *David Dettinger and R. D. Wengenroth*
A Rotary Joint for Two Microwave Transmission Channels of the Same Frequency Band (Abstract), *H. P. Raabe*

PGQC-2, March, 1953

A Variables Double Sampling Plan, *Joseph McDermott and Leon Bass*
Performance Evaluation of "Special Red" Tubes, *H. J. Prager*
Development of Inspection Manual for Reliable Tubes, *E. K. Wimpy*
Adaptation of Industry Proposals to Subminiature Tube Evaluation, *A. J. Heitner*
An Engineering Progress Report on Reliable Tubes, *R. E. Moe*
Institutional Listings

IRE People

William P. Maginnis (SM'45) has been made vice president and chief engineer of Federal Telephone and Radio Corporation, Clifton, N. J. He will direct telephone, radio and vacuum tube engineering.

W. P. Maginnis

Prior to joining Federal in 1951, Mr. Maginnis was with the Radio Corporation of America for 21 years, heading components engineering at the RCA Camden, N. J. plant.

Mr. Maginnis received the B.A. degree in 1929 from the University of Pennsylvania, where he was a Phi Beta Kappa student. He began his career in communications engineering at the Bell Telephone Laboratories, Inc., New York. In 1930 he left Bell Labs to begin his long association with RCA. In between various supervisory assignments at Camden he served as chief engineer at the RCA manufacturing plant in Bloomington, Ind.

❖

Marvin Hobbs (A'35–M'41–SM'43), formerly director of engineering, has been elected vice-president and a director of Harvey-Wells Electronics, Inc., of Southbridge, Mass.

Marvin Hobbs

Mr. Hobbs was born in Kyana, Ind., in 1912. He received the degree of B.S.E.E. at Tri-State College, Ind., in 1930.

Following graduation he embarked on his twenty years of association with various radio electronics and television industrial firms such as the Radio Corporation of America, Scott Laboratories, General Motors, and Zenith.

During World War II Mr. Hobbs was chief of the electronics branch of the Radio and Radar Division of the War Production Board, and operational analyst for the Far East Air Force of the U. S. Army. He then became a consulting engineer in Chicago for radio and television manufacturers. From 1950 to 1952 he was deputy executive director of the electronics division and electronics advisor of the Munitions Board, and a member of the Electronics Production Board of the Department of Defense.

Mr. Hobbs is a member of the RTMA Committee on Electronic Applications and numerous professional organizations including the American Geophysical Union, American Institute of Physics, American Meteorological Society, American Association for Advancement of Science, and the Institute of Aeronautical Sciences.

❖

Kenneth A. Hoagland (A'44–SM'52), formerly assistant engineering manager of the tube division of Allen B. DuMont Laboratories, Inc., has been promoted to chief engineer.

K. A. Hoagland

A native of New Jersey, Mr. Hoagland was born there on June 24, 1922. He received the B.S. degree in electrical engineering in 1948 from the Newark College of Engineering and the M.S. degree in 1950.

In 1940 and 1941 Mr. Hoagland was a laboratory assistant with the Automatic Winding Co. of East Newark. He has been with the DuMont Laboratories since 1942, first as a project engineer responsible for the design and construction of specialized test equipment for cathode-ray tubes, then from 1945–52 as senior engineer of the design and development section.

Mr. Hoagland has had numerous articles published in technical and trade journals. He is an associate of the American Institute of Electrical Engineers and a member of the American Physical Society and Tau Beta Pi.

Elmer H. Schulz (A'38–SM'46), formerly manager of the Physics and Electrica Engineering Divisions of the Armour Research Foundation, Chicago, Ill., has been advanced to the position of director of research.

Mr. Schulz was born in Lockhart, Texas, on October 30, 1913. He received the B.S. and M.S. degrees in electrical engineering in 1935 and 1936, respectively, from the University of Texas. Until 1942 he was a member of the staff of the electrical engineering department of the University.

Mr. Schulz then joined the staff of the same department of the Illinois Institute of Technology. In 1946 he became assistant chairman of the division of electrical engineering of the Armour Research Foundation of Illinois Institute, later chairman.

Mr. Schulz is a member of Tau Beta Pi and the American IEE.

❖

John R. Whinnery (A'41–SM'44–F'52) has been appointed vice-chairman of the Division of Electrical Engineering of the University of California in Berkeley. In charge of the Electronics Research Laboratory, he will be responsible for co-ordination of all research in electronics, including student, staff, and sponsored-project work.

Mr. Whinnery was born on July 26, 1916 in Read, Colo. He received the B.S. degree in electrical engineering from the University of California in 1937.

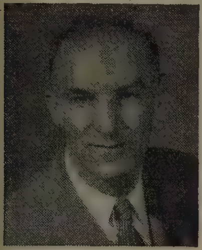
He then joined the General Electric Co., Schenectady, N. Y., and graduated from their program in advanced engineering in 1940. During the next two years he supervised the high-frequency section of the program. From 1942–46 he was with the electronics and the research laboratories.

Mr. Whinnery became a member of the staff of the University of California in 1946. While on leave from the University in 1951 and 1952 he headed the microwave tube section of the Electron Tube Laboratories of the Hughes Aircraft Company.

Mr. Whinnery has been active in IRE affairs as a member of the Papers and Handbook committees and the Board of Editors.

IRE People

Paul L. Morton (A'43–SM'45), professor, has been named chairman of the Division of Electrical Engineering of the University of California (in Berkeley).



PAUL L. MORTON

Dr. Morton was born May 14, 1906 in Silao, Mexico. He received the B.S. in electrical engineering degree from the University of Washington in 1931, the M.S. degree from the Massachusetts Institute of Technology in 1938, and the Ph.D. degree from the University of California in 1943.

From 1931–35 Dr. Morton was associated with Ford, Bacon, & Davis, Engineers, and the Puget Sound Power & Light Co. He taught at the University of Washington until 1937, and in 1943 was appointed assistant professor at the University of California. His recent work has been chiefly concerned with instruction and research in digital computer electronics.

❖

Samuel C. Miller (M'43–SM'43), an executive with the Tube Light Engineering Company of New York, N. Y., died recently. Mr. Miller was an early member of the Institute, having joined originally in 1916 as an Associate.

Mr. Miller was born on February 12, 1895 in Chicago, Ill., and received the degree of Professional Engineer from the University of the State of New York.

From 1914 to 1918 Mr. Miller was employed by the DeForest Radio Telephone and Telegraph Company in the design of radio apparatus for amateurs and the government. After a year of service as a second lieutenant in the Signal Corps, U. S. Army, he joined the Radio Corporation of America, research department. He was concerned with the design and development of commercial radio apparatus from research investigations.

Mr. Miller became associated with the Cleartron Vacuum Tube Company of West New York, N. J. and Birmingham, England, in 1925 as a vacuum tube engineer. In 1928 he became owner and executive engineer of the Tube Light Engineering Company of New York, N. Y. His work here was concerned with tube supplies and specialties. In 1942 Mr. Miller was commissioned a Captain in the Signal Corps, U. S. Army, and assigned to the Office of the Chief Signal Officer, Washington, D. C.

Professor Willis Jackson (A'28–M'31–SM'48) has been appointed director of research and education of the Metropolitan-Vickers Electric Company, Ltd., in Manchester, England, effective July 1.

Professor Jackson was born in 1904 in Burnley, England. He received the B.S. and M.S. degrees from Manchester University in 1925 and 1926, respectively.

Following graduation, Professor Jackson was a lecturer in electrical engineering at Technical College in Bradford until 1929. After a year with Metropolitan-Vickers he was a lecturer at the College of Technology in Manchester until 1933, when he became a demonstrator in the engineering laboratory at Oxford University. In 1936 he received the D.Sc. degree from Manchester University and the D.Phil. degree from Oxford University.

From 1936 to 1938 Professor Jackson was a research engineer with Metropolitan-Vickers. He then became professor of electrotechnics at the University of Manchester and head of the department of electrical engineering. Since 1946 he has held a similar post at the City and Guilds College of the Imperial College in London.

Professor Jackson is a member of the British IEE and the Scientific Advisory Council of the Ministry of Supply.

❖

Alfred Y. Bentley (S'42–A'44–SM'51), formerly engineering manager of the cathode-ray division of the Allen B. DuMont Laboratories, has been named chief engineer of the receiver division.

Born in Missouri on March 3, 1918, Mr. Bentley received the B.S. degree in electrical engineering from Washington University, St. Louis, Mo., in 1942.

From 1942 to 1945 Mr. Bentley was on the staff of the Radiation Laboratory at the Massachusetts Institute of Technology, where he worked on cathode-ray tube standardization for service applications. He operated as consultant for the Bureau of Ships, Navy Department, on cathode-ray tube field problems, and was chairman of Joint Army-Navy Sub-committee on Cathode-Ray Tubes.

Mr. Bentley joined the DuMont Laboratories in 1945 as assistant head of the cathode-ray tube engineering department, becoming the head in 1946.

❖

Edwin R. Rathburn, Jr. (S'48–A'51) has joined Radiation Counter Laboratories, Inc., of Chicago, Ill., as director of physical research. He will direct research on radiation detection equipment and nuclear reactor control instrumentation.

Born in Missouri on April 22, 1922, Mr. Rathburn received the B.S. degree in electrical engineering in 1948 and the M.S. degree in physics in 1950 from Iowa State College.

Following graduation, Mr. Rathburn worked in the Ames Laboratory at Iowa State as a junior physicist, doing developmental research in atomic, nuclear, chemical and metallurgical fields. Before joining the Radiation Counter Labs, he was with the Nuclear Instrument and Chemical Corporation of Chicago as an assistant technologist. His work there was concerned with research in design and development of radiation detectors and associated electronic systems for special purposes.

❖

Hermann E. Kranz (M'23–SM'47), formerly director of the technical institute division of the Lawrence Institute of Technology, in Detroit, Mich., has been appointed head of the electrical engineering department.

H. E. KRANZ

Mr. Kranz was born in Illinois on June 15, 1884. He received the A.B. degree in 1909 from Lawrence College, Appleton, Wis., and the B.S. in electrical engineering and professional E.E. degree from the University of Wisconsin in 1914 and 1917, respectively. He was an instructor in electrical engineering three years during this time.

From 1917–20 Mr. Kranz was employed as an engineer working on automotive electrical equipment with Briggs & Stratton Co. of Milwaukee, Wis. He then joined the Western Electric Co. as a manufacturing development engineer, concerned with telephone equipment. In 1926 he became chief engineer for Grigsby Grunow Co., later vice president in charge of engineering, where he was concerned with the manufacturing of domestic radio receivers and vacuum tubes, as well as components for the receivers.

From 1933–39 Mr. Kranz was an electrical and electronics consulting engineer in Chicago. In 1940 he became assistant chief engineer of the RBM Manufacturing Co., Logansport, Ind., where he was concerned with automotive electrical equipment. In 1942 he became operations manager of the radio division of Research Enterprises Ltd., Ontario, Canada, in charge of engineering, production, and inspection of radar equipment manufactured for the Allies.

In 1944 Mr. Kranz joined the radio division of the International Detrola Corp., Detroit, Mich., as assistant chief engineer in charge of administration and research. He became associated with the Lawrence Institute in 1950.

Mr. Kranz has been active in IRE affairs as an organizer and past chairman of the Chicago section, and as past chairman and present member of the executive committee of the Detroit section.

Mr. Kranz is a member of the Engineering Society of Detroit.

Report of the Secretary—1952

To the Board of Directors,
The Institute of Radio Engineers

Gentlemen:

Herewith is presented the usual annual report for Institute operations for the year 1952, giving data on membership, editorial department, technical activities, Section activities, and Student Branches. The Professional Group activities are included under the chapter on technical activities.

1952 was characterized by growth on all fronts. More members, larger Proceedings, a larger Directory, a larger Convention, and the phenomenal growth of the Professional Groups and their Transactions make your Institute still more important as the fundamental instrument of information and coordination in its expansive fields of endeavor.

Respectfully submitted,

Haraden Pratt

Haraden Pratt,
Secretary

January 23, 1953

Membership

At the end of the year 1952, the membership of the Institute, including all grades, was 32,874, an increase of 3,466, or 12 per cent over the previous year. The 3,466 member increase in 1952 was more than 2,233 and 406, the increases for 1950 and 1951, respectively. The percentage increase was 8 per cent in 1950, and 1.4 per cent in 1951. The membership trend from 1912 to date is shown graphically in Fig. 1.

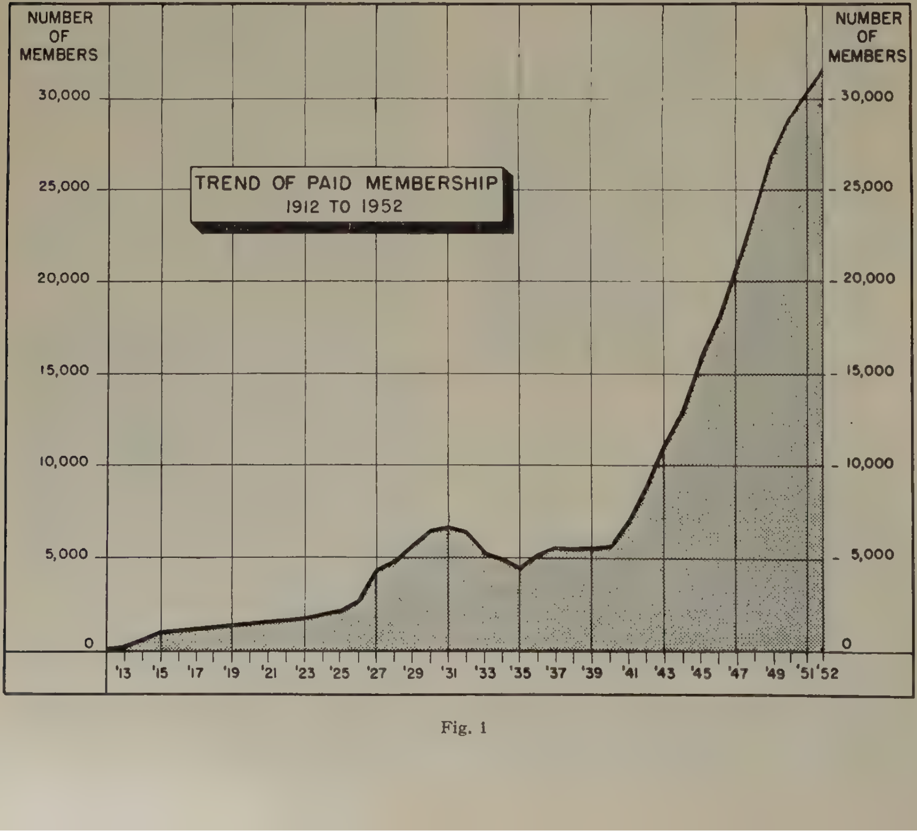


Fig. 1

Actual membership figures for 1950, 1951, and 1952 are shown in Table I. Of the 19,110 nonvoting Associates, 3,723 have been in that grade for more than five years. The membership ratio of Associates to higher grades is approximately 2 to 1.

TABLE I
Total Membership Distribution by Grades

Grade	*As of Dec. 31, 1952* *Number*	*Per cent of Total*	*As of Dec. 31, 1951* *Number*	*Per cent of Total*	*As of Dec. 31, 1950* *Number*	*Per cent of Total*
Fellow	379	1.2	345	1.2	323	1.1
Senior Member	3,566	10.8	3,070	10.4	2,726	9.4
Member	4,617	14.0	4,043	13.7	3,803	13.1
Associate	20,029***	61.0	17,523**	59.6	14,590*	50.3
Student	4,283	13.0	4,427	15.1	7,560	26.1
Totals	32,874		29,408		29,002	

* Includes 1,159 Voting Associates.
** Includes 974 Voting Associates.
*** Includes 919 Voting Associates

It is with deep regret that this office records the death of the following members of the Institute during the year 1952.

Fellows

Walter C. Evans (M'36–SM'43–F'45)
Alfred L. Green (A'28–F'38)
August Hund (M'16–F'27–L'52)
Samuel S. Mackeown (M'29–F'40)
H. Leslie McMichael (M'20–F'25)
Louis G. Pacent (A'12–M'15–F'27)

Senior Members

Charles B. Aiken (A'25–M'35–SM'43)
William C. Ballard, Jr. (SM'46)
John James Downing (SM'46)
Raymond E. Drake (SM'45)
Fred O. Grimwood (A'46–SM 49)
Charles H. Guiles (A'42–SM'51)
Edward C. Homer (A'28–SM'45)
M. Glenn Jarrett (A'38–SM'49)
Wallace J. Miller (SM'47)
W. C. Osterbrock (A'24–M'39–SM'43)
Earl George Ports (A'25–M'33–SM'43)
John F. Skirrow (M'27–SM'43)
Ernest J. Vogt (A'41–SM'49)

Members

Frank E. Gissler (A'45–M'48)
James C. Johnson (M'46)
Ralph R. Kenigson (M'53)
Stanley T. Kuduk (A 48–M 52)
Richard B. Paddock (M'46)
Paul F. Shuey (A'37–M'46)

Voting Associates

Allan K. Bayley (S'32–A'35–VA'39)
Francis Schaar Benson (A'28–VA'39)
Joseph F. Knapp (A'25–VA'39)
Henry Ladner (A'31–VA'39)
Liss C. Peterson (A'32–VA'39)

Associates

David R. Aiken (S'50–A'51)
John L. Bennett (S'51–A'53)
Bernard Blachere (A'47)
A. S. Bogatko, Jr. (S'49–A'49)
John G. Buttner (A'49)
Harry G. Fawcett (A'45)
Philip A. Gridley (S'48–A'50)
Arthur Hebb, Jr. (A'48)
Orville O. Hill (A'45)
Clifford E. Hodge (A'48)
Theodore H. Kemp (A'43)
Arthur James Leyland (A'40)
J. B. Morrissett (A'49)
Ralph J. Nicholls (S'49–A'50)
Roy S. L. Pelletier (S'50–A'50)
Albert L. Perley (A'41)
Raja Rao (A'47)
John Penfield Roberts (S'49–A'50)
David Schafferman (S'49–A'50)
Victor J. Weber (A'41)
Theodore Zuschlag (A'42)

Students

Joseph E. Anzino (S'50)
Orion P. Horne (S'52)
Clarence R. June (S'51)
James Barba LeGrazie (S'48)
William E. McGee (S'50)
Edward J. Runck (S'50)
William C. Scott (S'51)
Charles L. Warner (S'51)

Fiscal

A condensed summary of income and expenses for 1952 is shown in Table II, and a balance sheet for 1952 is shown in Table III.

TABLE II

SUMMARY OF INCOME AND EXPENSES, 1952

Income		
Advertising	$544,509.60	
Member Dues and Convention	594,731.73	
Subscriptions	60,110.96	
Sales Items—Binders, Emblems, etc.	31,041.91	
Investment Income	17,682.56	
Miscellaneous Income	529.43	
TOTAL INCOME		$1,248,606.19
Expense		
PROCEEDINGS Editorial Pages	$215,159.90	
Advertising Pages	273,976.05	
Directory	92,475.77	
Section and Student Branch Rebates	40,425.97	
Professional Group Expense	23,618.30	
Sales Items	16,378.26	
General Operations	256,394.78	
Convention Cost	167,753.34	
TOTAL EXPENSE		$1,086,182.37
Surplus		$ 162,423.82
Reserve for Depreciation		9,211.53
NET SURPLUS		$ 153,212.29

TABLE III

BALANCE SHEET—DECEMBER 31, 1952

Assets		
Cash and Accounts Receivable	$313,960.02	
Inventory	14,955.71	
Total Current Assets		$ 328,915.73
Investments at Cost	799,384.49	
Building and Land at Cost	356,687.30	
Furniture and Fixtures at Cost	108,257.86	
Other Assets	23,231.07	
TOTAL		1,287,560.72
TOTAL ASSETS		$1,616,476.45
Liabilities and Surplus		
Accounts Payable	$ 16,683.43	
Federal Taxes on Emblems, Etc.	86.66	
Total Current Liabilities		$ 16,770.09
*Deferred Liabilities	387,453.03	
Professional Group Funds on Deposit	33,383.07	
Total Other Liabilities		420,836.10
Total Liabilities		$ 437,606.19
Reserve for Depreciation		39,477.41
Surplus—Donated	595,530.38	
Surplus—Earned	543,862.47	
TOTAL SURPLUS		1,139,392.85
TOTAL LIABILITIES AND SURPLUS		$1,616,476.45

* 1953 items, PROCEEDINGS for members and subscribers, Advertising and Convention Service.

Editorial Department

Proceedings of the I.R.E.

The year 1952 was highlighted by publication in November of the largest issue of PROCEEDINGS ever to appear, the 532-page transistor issue. The issue was the second in a series of special issues devoted to one subject.

The total number of pages published in the PROCEEDINGS during the year was 3,604, including covers, a marked increase over previous years. The number of PROCEEDINGS pages published in each of the last four years is given in Table IV. The number of editorial pages published each year since 1913 is shown in Fig. 2.

TABLE IV

VOLUME OF PROCEEDINGS PAGES

	1952	*1951*	*1950*	*1949*
Editorial	1,804	1,628	1,516	1,532
Advertising	1,800	1,424	1,016	872
Total	3,604	3,052	2,532	2,404

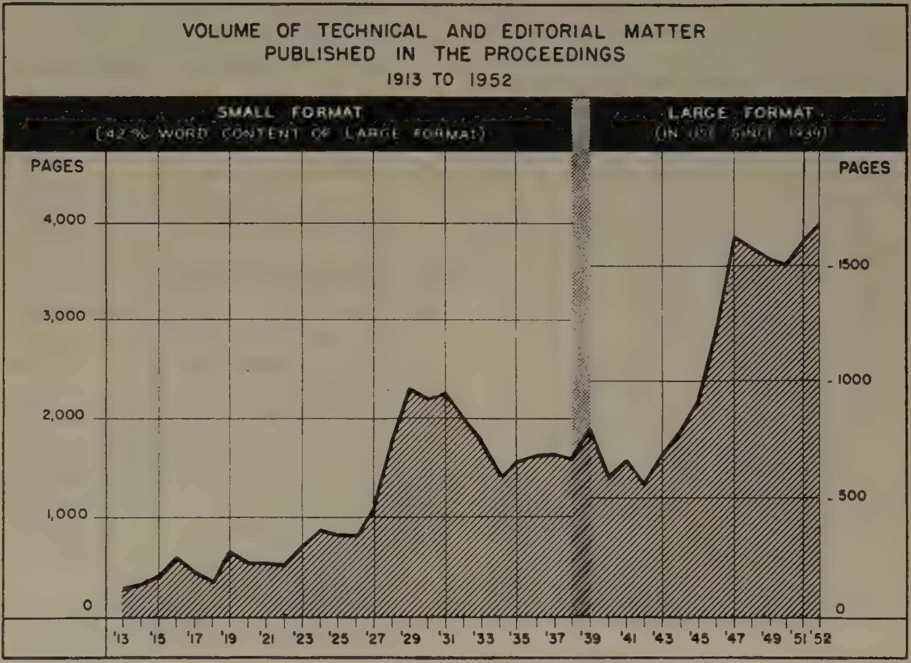


Fig. 2

Technical papers totaling 235 were published in 1952, as against 173 in 1951. In addition, 5 IRE Standards were published in 1952 as against 8 in 1951. Authorship of these papers was by 313 individuals of whom 224, or 72 per cent, were members of the Institute. In 1951, 175 of the 239 authors, or 73 per cent, were members.

Several IRE committees and Professional Groups assisted in the procurement and review of PROCEEDINGS papers. As a result, 13 such papers were published with the approval of the following: 8 papers approved by Professional Groups, 3 by the Tutorial Papers Subcommittee of the Education Committee, 1 by the Standards Committee, and 1 by the Video Techniques Committee.

The volume of papers submitted for publication increased substantially. During 1952, 339 papers totaling an estimated 2,162 PROCEEDINGS pagges were submitted, or an average of 28 papers and 180 pages per month. During 1951, 241 papers of 1,680 pages were received, or 20 papers and 140 pages per month.

The backlog of papers on hand in the Editorial Department at the end of 1952 consisted of 86 papers totaling 546 PROCEEDINGS pages, of which 45 papers or 265 pages had been accepted for publication, the remainder being under review. This represented a significant improvement over the backlog total at the end of 1951 of 153 papers or 704 pages.

Professional Groups Transactions

The year 1952 saw a healthy growth in the publication activities of the Professional Groups of the IRE. As a result, during 1952 the Editorial Department published 22 issues of TRANSACTIONS totaling 189 papers and 1,474 pages for 10 Groups, as compared with the 1951 totals of 6 issues totaling 6 papers and 98 pages for 2 Groups. The total volume of TRANSACTIONS material published to date is given in Table V.

TABLE V

VOLUME OF TRANSACTIONS MATERIAL PUBLISHED, 1951 AND 1952

Group	*Issues*	*Pages*
Airborne Electronics	6	114
Antennas and Propagation	4	636
Audio	10	268
Broadacst and Television Receivers	1	16
Circuit Theory	1	104
Electron Devices	1	36
Electronic Computers	1	80
Instrumentation	1	68
Quality Control	1	62
Vehicular Communications	2	188
Total	28	1,572

IRE Directory

The 1952 IRE Directory was the largest Directory published to date, containing 856 pages including covers, of which 357 were membership listings and information, 499 were advertisements and listings of manufacturers and products. The 1951 Directory totaled 766 pages.

Department Organization

The Editorial Department is directed by Editor Alfred N. Goldsmith in matters of editorial policy, content, and format, and by Executive Secretary George W. Bailey in matters of finance and administration. Both function through Administrative Editor E. K. Gannett and an effective staff. It has been greatly assisted by the counsel and cooperation unstintingly given by the members of the Board of Editors, Papers Review Committee, and the Administrative Committee of the Board of Editors.

Technical Activities

Technical Committees

There were 166 Technical Committee meetings during 1952. This figure includes meetings of the 23 main committees, as well as subcommittees and task groups. A total of 133 were held at IRE headquarters; the remaining 33 elsewhere.

The activities of the IRE Technical Committees are reported monthly in the PROCEEDINGS.

The policy of publishing Standards in the PROCEEDINGS, as initiated in 1949, is being continued. The Standards listed below were published in 1952 and are available to the industry:

52 IRE 7. S1—*Standards on Magnetrons: Definitions of Terms, 1952*

52 IRE 7. S2—*Standards on Gas-Filled Radiation Counter Tubes: Methods of Testing, 1952*

52 IRE 7. S3—*Standards on Gas-Filled Radiation Counter Tubes: Definitions of Terms, 1952*

52 IRE 20. S2—*Standards on Pulses: Definitions of Terms, Part II*

51 IRE 17. S1 (Supplement)—*Practical Considerations in Measuring VHF Receiver Oscillator Radiation*

52 IRE 17. S1—*Standards on Receivers: Definitions of Terms*

In addition to standardization work done on the above, the following Standards were adopted by the Standards Committee and Submitted for Executive Committee approval during the latter part of 1952. They will appear in the PROCEEDINGS at an early date:

Standards on Sound Recording and Reproducing: Methods of Measurement of Noise
Standards on Television: Definitions of Color Terms
Standards on Modulation Systems: Definitions of Terms

There has been no change in the number of main technical committees. Eighteen new subcommittees and task groups have been set up for specific purposes during 1952. There are now 83 subcommittees and task groups within the IRE Technical Committee structure. Several Chairmen have appointed ad hoc committees to survey future work and reorganize and activate subcommittees.

Professional Group System

There are nineteen Professional Groups presently active.

During the year 1952, eighteen of the Groups sponsored national meetings, joint symposia with other professional societies, and technical sessions. Ten Groups sponsored technical sessions at the 1952 National Convention. Fourteen Groups sponsored the technical sessions at the 1952 West Coast Convention at Long Beach, Calif.

At the National Electronics Conference held in Chicago, the IRE was represented by the Audio and Engineering Management Professional Groups, both of which sponsored technical sessions.

The Joint IRE-AIEE-RTMA Conference on Quality Electronic Components, held in Washington, was sponsored by the Professional Group on Instrumentation and was attended by over 1,050 persons. This Group also sponsored sessions at the Annual Meeting of the Instrument Society of America, held in Cleveland, and at the Centennial of Engineering in Chicago.

More than 1,000 persons attended the Joint IRE-AIEE-ACM Computer Conference, held in December in New York City. IRE sponsorship was through the Professional Group on Electronic Computers which also sponsored a Computer Conference at the University of California, Los Angeles, jointly with the Department of Engineering of the University.

The IRE-IAS-ION-RTCA Symposium on Air Traffic Control, held in New York, was sponsored by the Professional Group on Airborne Electronics at the National Meeting of The Institute of the Aeronautical Sciences. This Group also sponsored the National Conference on Airborne Electronics in Dayton, Ohio.

At the IRE-RTMA Radio Fall Meeting, held in Syracuse, the technical sessions were sponsored by the Professional Groups on Broadcast and Television Receivers, Electron Devices, and Quality Control.

The Joint URSI-IRE meeting, held in Washington, was sponsored by the Professional Group on Antennas and Propagation. Several members of the Group also attended the General Assembly of the URSI, held in Sydney, Australia.

The Joint IRE-AIEE Scintillation Counter Symposium, held in Washington, was sponsored by the Professional Group on Nuclear Science and was attended by 400 persons.

The Third Annual Meeting of the Vehicular Communications Professional Group was held in Washington. This was a three-day meeting comprising a technical program and demonstrations.

The Second Annual Meeting of the Professional Group on Broadcast Transmission Systems was held at the Franklin Institute in Philadelphia.

The Industrial Electronics Professional Group sponsored a symposium on "Electronics and Machines" in Chicago.

The Microwave Theory and Techniques Professional Group sponsored a national meeting on "Microwave Circuits" in New York City.

The Communications Systems Professional Group sponsored two symposia at Brentwood, Long Island and at the Coles Signal Laboratory.

Professional Groups publication activities are reported under the Editorial Department Section of this report.

Professional Group activity within the Sections is increasing rapidly. There are forty-four official Chapters operating within the Sections at the present time. All Professional Groups have appointed Sectional Activities Committees to stimulate interest in Chapters in the various Sections.

Institute Representatives on Other Bodies

The majority of IRE representatives on other bodies were appointed for a one-year period, May 1, 1952 to April 30, 1953. (For a current listing, see page 819 of this issue).

The IRE representatives who have been assisting the State Department with problems relating to the International Radio Consultative Committee (CCIR), of the International Telecommunications Union, collaborated with the Government in preparatory work for the next plenary assembly scheduled for 1953.

In March 1952 the Policy Committee for Release of Technical Information of the Atomic Energy Commission was reconstituted as a permanent committee with revised terms of reference and some changes in membership.

The Joint IRE-AIEE Committee on High Frequency Measurements has organized the 3rd Conference on High Frequency Measurements, to be held in Washington in January, 1953.

The IRE Representative on the URSI Executive Committee advised that a major part of the efforts in 1952 were concerned with the arrangements for the 10th General Assembly of URSI held in Sydney, Australia in August. Reports regarding this Assembly will be made at the winter meeting of URSI.

Joint Technical Advisory Committee

The Joint Technical Advisory Committee (JTAC) held nine meetings during 1952.

Three volumes were published by JTAC during 1952. Volumes VII and IX each included (a) Section I—Official correspondence between the Federal Communications Commission and the Joint Technical Advisory Committee (IRE-RTMA) with other items pertinent to the actions of the JTAC, and (b) Section II—Approved minutes of meetings of the Joint Technical Advisory Committee (IRE-RTMA). Volume VII, which was issued in January, 1952, covered the period July 1, 1950 to June 30, 1951 and Volume IX, issued in December, 1952, covered the period July 1, 1951 to June 30, 1952.

Volume VIII of the JTAC Proceedings, entitled "Radio Spectrum Conservation," was published in book form. In the interest of public service, the JTAC and its sponsors, the IRE and RTMA, mailed a total of 2,225 volumes throughout the world to professional societies, industry groups, government officials, educational institutions, libraries, technical publications, research laboratories, and so forth.

The JTAC Subcommittee on Land-Mobile Channel Allocations held four meetings during 1952, including four days of field testing in Syracuse, N. Y. Additional field testing and demonstrations were held in Camden, N. J. This Subcommittee was organized on October 9, 1951 to act as consultant to the JTAC in the preparation of a reply to the FCC regarding its request for information as to channel allocations for communication services. It is expected that conclusions and recommendations will be available early in 1953.

A subcommittee was organized in February, 1952 to undertake a study aimed toward recommendations for the simplification of the FCC's technical requirements contained in their Rules and Regulations and in their Standards of Good Engineering Practice. This Subcommittee includes four activities, i.e., aeronautical, broadcast, marine services, and land-mobile.

The JTAC has undertaken, at the request of the Federal Communications Commission, a comprehensive study of the increasingly important problem of interference. The problem relates particularly to several fields presenting difficulties of current concern to the Commission. Certain aspects of the problem have been assigned by JTAC to IRE and RTMA.

National Television System Committee

The Institute continued to provide assistance for the work of the National Television System Committee. 75 meetings of the NTSC were held at Institute headquarters in 1952.

Section Activities

We were glad to welcome five new Sections into the Institute during the past year. They are as follows:

Binghamton (March, 1952)
Central Florida (September, 1952)
El Paso (September, 1952)
Hamilton (May, 1952)
Little Rock (March, 1952)

The total number of Sections is now 65. There has been a membership increase in 51 of the 65 Sections.

The Binghamton and Hamilton Subsections became full Sections, and the Urbana Subsection was dissolved in the year 1952. The Subsections of Sections now total 15, the following being formed in 1952:

Charleston (Atlanta Section) February, 1952
Huntsville (Atlanta Section) July, 1952
Orange Belt (Los Angeles Section) November, 1952
Wichita (Kansas City Section) May, 1952

Student Branches

The number of Student Branches formed during 1952 was 5, all of which operate as Joint IRE-AIEE Branches. The total number of Student Branches is now 114, 76 of which operate as Joint IRE-AIEE Branches.

Following is a list of the Student Branches formed during the year: Brown University, University of New Hampshire, North Dakota Agricultural College, Ohio University, and West Virginia University.

Institute Committees—1953

EXECUTIVE

J. W. McRae, *Chairman*
W. R. G. Baker, *Vice-Chairman*
Haraden Pratt, *Secretary*
S. L. Bailey
A. N. Goldsmith
W. R. Hewlett
D. B. Sinclair

CONSTITUTION AND LAWS

R. A. Heising, *Chairman*
I. S. Coggeshall
J. B. Coleman
A. W. Graf
R. F. Guy
H. R. Zeamans

PROFESSIONAL GROUPS

W. R. G. Baker, *Chairman*
L. C. Van Atta, *Vice Chairman*
B. B. Bauer
L. M. Clement
W. L. Everitt
A. W. Graf
R. A. Heising
J. H. Howard
D. D. Israel
G. F. Metcalf
W. M. Rust, Jr.
P. C. Sandretto
Harner Selvidge
Ernst Weber
(Professional Group Chairmen Ex-Officio)

FINANCE

W. R. G. Baker, *Chairman*
S. L. Bailey
W. R. Hewlett
A. V. Loughren
J. W. McRae, Ex-officio
D. B. Sinclair

AWARDS

Ernst Weber, *Chairman*
R. M. Bowie
J. F. Byrne
L. T. DeVore
J. F. Morrison
A. B. Oxley
J. D. Reid
W. M. Rust, Jr.
J. E. Shepherd
L. C. Van Atta
A. F. Van Dyck
H. W. Wells

EDUCATION

J. D. Ryder, *Chairman*
R. G. Anthes
G. R. Arthur
V. A. Babits
C. G. Brennecke
W. L. Cassell
C. C. Chambers
D. H. Ewing
R. M. Fano
C. L. Foster
A. W. Graf
A. E. Harrison
H. E. Hartig
R. W. Hickman
G. B. Hoadley
G. L. Hollander
A. H. Howell
F. S. Howes
Glenn Koehler
A. W. Melloh
H. A. Moench
P. H. Nelson
J. M. Pettit
Albert Preisman
L. R. Quarles
J. R. Ragazzini
H. J. Reich
V. C. Rideout
F. R. Stansel
W. N. Tuttle
D. L. Waidelich
L. E. Williams
D. G. Wilson
A. H. Wing, Jr.

POLICY ADVISORY

J. D. Ryder, *Chairman*
K. C. Black
W. H. Doherty
Ferdinand Hamburger, Jr.
T. A. Hunter
F. B. Llewellyn
A. V. Loughren
A. W. Straiton

NOMINATIONS

W. H. Doherty, *Chairman*
I. S. Coggeshall
A. W. Graf
A. B. Oxley
J. R. Ragazzini
D. B. Sinclair
A. W. Straiton
F. E. Terman

TELLERS

Vincent Learned, *Chairman*
W. F. Bailey
J. F. Craib
J. H. Mulligan, Jr.
A. K. Wing, Jr.

ADMISSIONS

H. P. Corwith, *Chairman*
E. W. Bemis
H. S. Bennett
*T. M. Bloomer
*H. A. Brown
C. M. Burrill
*E. T. Dickey
*V. J. Duke
*Leonard Goldstone
*R. E. Gray
C. A. Hachemeister
H. R. Holloway
M. B. Kline
F. S. Mabry
*F. L. Marx
*H. G. Miller
D. M. Pasek
D. C. Pinkerton
G. B. Riley
H. R. Terhune
H. C. Vance
*J. D. Winer

* Alternates.

MEMBERSHIP

W. C. White, *Chairman*
Kipling Adams
F. W. Albertson
A. R. Beach
T. H. Clark
A. W. Keen
A. B. Oxley
D. B. Sinclair
G. R. Town
L. C. Van Atta
(Chairmen of Section Membership Committees Ex-Officio)
(Regional Directors Ex-Officio)

PUBLIC RELATIONS

Lewis Winner, *Chairman*
E. L. Bragdon
W. C. Copp
H. E. Fry
E. K. Gannett
R. F. Guy
T. R. Kennedy, Jr.
H. S. Renne
Bruce Robertson
E. C. Tompson
(Chairmen of Section Publicity Committees Ex-Officio)

SECTIONS

Irving Wolff, *Chairman*
(Chairmen of Sections Ex-Officio)

BOARD OF EDITORS

A. N. Goldsmith, *Chairman*

F. W. Albertson
W. S. Bachman
G. M. K. Baker
W. L. Barrow
R. R. Batcher
J. H. Battison
B. B. Bauer
H. S. Black
Ralph Bown
R. S. Burnap
O. H. Caldwell
C. W. Carnahan
C. C. Chambers
L. M. Clement
J. D. Cobine
J. W. Coltman
M. G. Crosby
R. C. Curtis
R. L. Dietzold
R. B. Dome
W. G. Dow
W. L. Everitt
W. G. H. Finch
D. G. Fink
H. C. Forbes
I. A. Getting
L. J. Giacoletto
A. W. Graf
F. W. Grover
E. A. Guillemin
A. V. Haeff
D. B. Harris
L. B. Headrick
E. W. Herold
J. K. Hilliard
C. J. Hirsch
R. G. E. Hutter
J. K. Johnson
L. F. Jones
H. S. Knowles
J. B. H. Kuper
S. C. Lawrence
D. G. Little
F. B. Llewellyn
E. D. McArthur
Knox McIlwain
Nathan Marchand
G. F. Metcalf
E. L. Nelson
D. O. North
K. A. Norton
H. F. Olson
G. D. O'Neill
R. M. Page
H. O. Peterson
G. W. Pickard
Haraden Pratt
C. A. Priest
J. R. Ragazzini
Simon Ramo
H. J. Reich
F. X. Rettenmeyer
H. H. Scott
Stuart Seeley
V. W. Sherman
L. C. Smeby
C. E. Smith
Newbern Smith
J. A. Stratton
G. C. Sziklai
W. C. Tinus
K. S. Van Dyke
E. K. Van Tassel
Ernst Weber
H. A. Wheeler
J. R. Whinnery
W. C. White
L. E. Whittemore
J. B. Wiesner
Irving Wolff
H. A. Zahl
V. K. Zworykin

ADMINISTRATIVE COMMITTEE OF THE BOARD OF EDITORS

A. N. Goldsmith, *Chairman*

G. M. K. Baker
H. S. Black
R. M. Bowie
R. S. Burnap
R. L. Dietzold
L. J. Giacoletto
F. B. Llewellyn
Knox McIlwain
K. A. Norton
F. X. Rettenmeyer
Newbern Smith
G. C. Sziklai
H. A. Wheeler
L. E. Whittemore
H. A. Zahl

PAPERS REVIEW

G. F. Metcalf, *Chairman*

M. A. Acheson
H. A. Affel
W. J. Albersheim
D. B. Anderson
V. A. Babits
Ross Bateman
P. H. Betts
F. J. Bingley
D. S. Bond
B. B. Brown
D. R. Brown
Kenneth Bullington
R. P. Burr
J. K. Clapp
S. B. Cohn
H. V. Cottony
F. W. Cunningham
L. T. DeVore
A. R. D'Heedene
M. J. Di Toro
H. D. Doolittle
O. S. Duffendack
W. A. Edson
Joseph Feinstein
E. H. Felix
L. M. Field
J. W. Forrester
V. H. Fraenckel
R. L. Freeman
E. G. Fubini
H. P. Gates, Jr.
W. M. Goodall
A. J. Grossman
O. B. Hanson
A. E. Harrison
Walter Hausz
T. J. Henry
W. R. Hewlett
Gunnar Hok
C. N. Hoyler
P. K. Hudson
W. H. Huggins
Henry Jasik
E. C. Jordan
A. G. Kandoian
Martin Katzin
R. W. P. King
C. R. Knight
W. E. Kock
Emile Labin
J. J. Lamb
M. T. Lebenbaum
Meyer Leifer
C. V. Litton
A. B. Macnee
W. P. Mason
R. E. Mathes
J. O. Mesa
H. R. Mimno
J. A. Morton
Garrard Mountjoy
A. F. Murray
J. R. Nelson
C. H. Page
R. C. Palmer
H. W. Parker
W. H. Pickering
Albert Preisman
C. F. Quate
H. E. Roys
John Ruze
W. E. Ryan
J. D. Ryder
A. L. Samuel
H. A. Samulon
R. K. F. Scal
L. S. Schwartz
Samuel Seely
Harner Selvidge
R. F. Shea
R. T. Silberman
Richard Silberstein
David Sillman
George Sinclair
J. E. Smith
W. M. Smith
A. E. Smoll
R. L. Snyder, Jr.
Harold Staras
J. R. Steen
G. R. Sugar
C. S. Szegho
H. P. Thomas
C. E. Torsch
Bertram Trevor
L. C. Van Atta
S. N. Van Voorhis
J. M. Watts
R. C. Webb
J. R. Weiner
K. R. Wendt
M. S. Wheeler
O. C. Woodyard
Victor Young
H. R. Zeamans

Special Committees

ARMED FORCES LIAISON COMMITTEE

G. W. Bailey, *Chairman*

IRE-IEE INTERNATIONAL LIAISON COMMITTEE

F. S. Barton
Ralph Bown
R. H. Davies
Willis Jackson
F. B. Llewellyn
C. G. Mayer
R. L. Smith-Rose
J. A. Stratton

PROFESSIONAL RECOGNITION

G. B. Hoadley, *Chairman*

C. C. Chambers
H. F. Dart
W. E. Donovan
C. M. Edwards

Technical Committees

May 1, 1953–April 30, 1954

20. STANDARDS COMMITTEE

A. G. Jensen, *Chairman*
M. W. Baldwin, Jr., *Vice Chairman*
L. G. Cumming, *Vice Chairman*
E. Weber, *Vice Chairman*

K. E. Anspach
J. Avins
R. R. Batcher
J. G. Brainerd
W. R. Bennet
F. T. Budelman
H. Burkhard
C. A. Cady
P. S. Carter
A. G. Clavier
J. L. Dalke
A. W. Friend
F. J. Gaffney
W. D. Goodale, Jr.
R. A. Hackbusch
P. J. Herbst
J. G. Kreer
W. P. Mason
J. Z. Millar
G. D. O'Neill
C. H. Page
W. M. Pease
W. J. Poch
D. C. Ports
P. C. Sandretto
R. Serrell
R. F. Shea
R. E. Shelby
N. Smith
W. G. Tuller

SUBCOMMITTEES

20.4 Television Co-ordination

M. W. Baldwin, Jr., *Chairman*
J. E. Keister

20.5 Definitions Co-ordinating

M. W. Baldwin, Jr., *Chairman*

P. S. Carter
P. J. Herbst
J. G. Kreer, Jr.
E. A. Laport

20.8 Basic Terms

J. G. Brainerd, *Chairman*

M. W. Baldwin, Jr.
C. H. Page

1. ANNUAL REVIEW

J. Z. Millar, *Chairman*

2. ANTENNAS AND WAVEGUIDES

D. C. Ports, *Chairman*
P. H. Smith, *Vice Chairman*

P. S. Carter
J. M. DeBell
G. A. Deschamps
J. E. Eaton
H. A. Finke
A. Gardner Fox
S. Frankel
A. G. Giordano
H. Jasik
O. E. Kienow
R. L. Mattingly
John Ruze
G. Sinclair

SUBCOMMITTEES

2.2 Waveguide and Transmission Line Definitions

P. H. Smith, *Chairman*

G. Deschamps
H. Jasik
R. L. Mattingly

2.3 Antennas and Waveguides West Coast Subcommittee

S. Frankel, *Chairman*

E. T. Jaynes
S. Kerber
T. Moreno
N. Schrock
S. Sensiper
S. Silver
R. S. Wehner

3. AUDIO TECHNIQUES

C. A. Cady, *Chairman*
D. E. Maxwell, *Vice Chairman*

H. W. Augustadt
W. Lindsay Black
D. H. Castle
J. K. Hilliard
I. M. Kerney
R. A. Miller
W. E. Stewart

SUBCOMMITTEES

3.1 Definitions of Audio Systems and Components Excluding Recording

H. W. Augustadt, *Chairman*

J. A. Green
H. D. Harris
F. L. Hopper

3.2 Methods of Measurement of Audio Systems and Components Excluding Recording

D. E. Maxwell, *Chairman*

W. L. Black
W. W. Dean
I. G. Easton
R. H. Edmondson
I. M. Kerney
W. E. Stewart

4. CIRCUITS

W. R. Bennett, *Chairman*

J. T. Bangert
J. G. Brainerd
A. R. D'heedene
T. R. Finch
R. M. Foster
W. H. Huggins
H. L. Krauss
J. G. Linvill
W. A. Lynch
S. J. Mason
P. F. Ordung
E. H. Perkins
E. J. Robb
W. N. Tuttle
F. H. Williams

SUBCOMMITTEES

4.1 Transistor Circuitry

J. G. Linvill, *Chairman*

T. R. Finch
A. W. Lo
S. J. Mason
J. J. Suran
L. Weinberg
F. H. Williams

4.2 Linear Lumped-Constant Passive Circuits

R. L. Dietzold, *Chairman*

J. G. Brainerd
A. R. D'heedene
R. M. Foster
H. Krauss
C. H. Page
W. N. Tuttle

4.3 Circuit Topology

R. M. Foster, *Chairman*

R. L. Dietzold
S. Goldman
E. A. Guillemin
J. Riordan

4.4 Linear Varying-Parameter and Non-Linear Circuits

W. R. Bennett, *Chairman*

J. G. Kreer, Jr.
C. H. Page
J. R. Weiner

4.5 Time-Domain Network Analysis and Synthesis

W. H. Huggins, *Chairman*

S. Goldman
W. H. Kautz
J. G. Linvill
S. J. Mason
D. F. Tuttle, Jr.

4.7 Linear Active Circuits Including Networks with Feedback and Servomechanism Circuits

W. A. Lynch, *Chairman*

H. Lauer
J. G. Linvill
J. M. Manley
E. H. Perkins
J. R. Ragazzini
C. F. Rehberg

4.8 Circuit Components

A. R. D'heedene, *Chairman*

4.9 Fundamental Qualities

H. L. Krauss, *Chairman*

P. F. Ordung
J. D. Ryder

6. ELECTROACOUSTICS

W. D. Goodale, Jr., *Chairman*
B. B. Bauer, *Vice Chairman*

Michel Copel
H. C. Hardy
A. S. Hegeman, Jr.
W. F. Meeker
H. F. Olson
R. J. Rockwell
V. Salmon
E. S. Seeley
P. S. Veneklasen

7. ELECTRON DEVICES

G. D. O'Neill, *Chairman*
R. M. Ryder, *Vice Chairman*

E. M. Boone
R. S. Burnap
W. J. Dodds
G. A. Espersen
W. R. Ferris
M. S. Glass
T. J. Henry
M. E. Hines
R. B. Janes
S. F. Kaisel
J. W. Kearney
G. Ross Kilgore
I. E. Mouromtseff
L. S. Nergaard
H. L. Owens
P. A. Redhead
A. C. Rockwood
W. G. Shepherd
R. W. Slinkman
C. M. Wheeler

SUBCOMMITTEES

7.2 Cathode-Ray and Television Tubes

R. B. Janes, *Chairman*

K. A. Hoagland
R. G. Stoudenheime

7.3 Gas Tubes

H. L. Thorson, *Chairman*

J. H. Burnett
W. A. Depp
E. J. Handley
R. A. Herring
D. E. Marshall
W. C. Schmitt
W. W. Watrous
W. M. Webster
H. H. Wittenberg

7.3.1 Task Group on Methods of Test for TR and ATR Tubes

K. Garoff, *Chairman*

H. F. Baker
I. Birnbaum
T. R. Bristol
W. R. Hayter
H. Heins
F. McCarthy
L. W. Roberts
M. S. Wheeler

7.4 Power Output High-Vacuum Tubes

C. E. Fay, *Chairman*

J. W. Clark
H. D. Doolittle
T. A. Elder
G. A. Espersen
J. W. Greer
I. E. Mouromtseff
E. E. Spitzer
C. Veronda
W. G. Wagener
C. M. Wheeler
A. K. Wing

7.4.1 Magnetron Working Group Under POHVT

G. A. Espersen, *Chairman*
R. R. Moats, *Secretary*

N. Alstad
R. S. Briggs
H. W. Cole
T. P. Curtis
M. S. Glass
B. Kumpfer
E. C. Okress
S. Weston

7.6 Small High-Vacuum Tubes

T. J. Henry, *Chairman*

E. M. Boone
R. C. Hergenrother
L. N. Heynick
M. E. Hines
E. H. Hurlburt
I. Meth (alternate)
W. T. Millis
W. G. Shepherd
R. W. Slinkman

7.6.2 Task Group on Traveling-Wave Tubes

M. E. Hines, *Chairman*

H. D. Arnett
W. J. Dodds
L. M. Field
R. G. E. Hutter
J. R. Pierce
S. E. Webber

7.6.3 Task Group on Noise Under SSHVT

R. M. Ryder, *Chairman*

J. J. Freeman
W. A. Harris
D. O. North
E. K. Stodola

7.7 Solid State Devices

R. M. Ryder, *Chairman*

A. E. Anderson
S. J. Angello
C. B. Brown
W. C. Dunlap
J. R. Flegal
R. W. Grantham
J. Kurshan
H. L. Owens
W. J. Pietenpol
B. J. Rothlein
E. J. Sees

7.7.2 Semiconductors—Methods of Test

W. J. Pietenpol, *Chairman*

D. A. Alsberg
A. Coblenz
L. J. Giacoletto
H. F. Heath
C. L. Rouault

7.7.3 Semiconductors—Definitions

S. J. Angello, *Chairman*

R. B. Adler
J. M. Early
B. J. Rothlein
J. S. Schaffner
K. Uhler

7.7.4 Methods of Test

J. J. Ebers, *Chairman*

A. W. Berger
B. N. Slade
R. L. Trent
J. Weisman
R. L. Wooley

7.11 Test Methods for High-Vacuum Microwave Tubes

G. A. Espersen, *Chairman*

E. M. Boone
J. H. Bryant
H. W. Cole
L. M. Field
M. S. Glass
A. E. Harrison
M. E. Hines
R. A. LaPlante
R. R. Moats
C. R. Moster
W. G. Shepherd
S. Weston

7.11.1 Task Group on Non-Operating Characteristics of Microwave Tubes

G. A. Esperson, *Chairman*

B. Arfin
E. M. Boone
M. S. Glass
E. D. Reed
S. Weston

7.11.2 Task Group on Operating Measurements of Microwave Oscillator Tubes

R. R. Moats, *Chairman*

(Committee 7.11.2 cont.)

R. S. Briggs
T. P. Curtis
C. Dodd
G. I. Klein
B. D. Kumpfer
R. A. LaPlante
E. C. Okress
R. Unger

CONSULTANTS

G. E. Hackley
A. E. Harrison
O. C. Lundstrom
E. D. McArthur
W. G. Shepherd

7.11.3 Task Group on Operating Measurements of Microwave Amplifier Tubes

H. W. Cole, *Chairman*

C. Dodd
H. Hersh
R. G. E. Hutter
A. W. McEwan
C. R. Moster
R. W. Peter
S. E. Webber

CONSULTANTS

J. H. Bryant
M. Chodorow
C. C. Cutler
L. M. Field
A. E. Harrison
M. E. Hines
V. R. Learned
L. D. Smullin
D. Watkins

Ad Hoc Committee To Make Critical Review of Organization of Committee 7

M. E. Hines, *Chairman*

R. S. Burnap
L. S. Nergaard
G. D. O'Neill
R. M. Ryder

8. ELECTRONIC COMPUTERS

R. Serrell, *Chairman*
D. R. Brown, *Vice Chairman*

S. N. Alexander
R. D. Elbourn
M. Middleton, Jr.
G. W. Patterson
J. A. Rajchman
N. Rochester
C. V. L. Smith
R. L. Snyder, Jr.
W. H. Ware
C. R. Wayne
J. R. Weiner
C. F. West
Way Dong Woo

SUBCOMMITTEES

8.3 Static Storage Elements

J. Rajchman, *Chairman*

A. O. Black
T. H. Bonn
H. R. Brownell
T. C. Chen
E. Gelband
M. K. Haynes
C. G. Horstman
M. Littmann
A. Nyman
W. M. Papian
E. A. Sands
N. B. Saunders
D. H. Toth

8.4 Definitions (Eastern Division)

N. Rochester, *Chairman*

R. D. Elbourn
L. C. Hobbs
R. P. Mayer
G. W. Patterson
J. R. Weiner

8.5 Definitions (Western Division)

W. H. Ware, *Chairman*

H. T. Larson
W. E. Smith
W. S. Speer
L. D. Stevens
R. Thorensen

8.6 Magnetic Recording for Computing Purposes

S. N. Alexander, *Chairman*

9. FACSIMILE

H. Burkhard, *Chairman*
A. G. Cooley, *Vice Chairman*

C. K. Clauer
I. H. Franzel
J. Hackenberg
F. A. Hester
J. V. Hogan
S. A. Lawson
P. Mertz
K. W. Pfleger
C. J. Young
R. J. Wise

10. INDUSTRIAL ELECTRONICS

J. L. Dalke, *Chairman*
E. Mittelmann, *Vice Chairman*

G. P. Bosomworth
J. M. Cage
E. W. Chapin
J. E. Eiselein
C. W. Frick
G. W. Klingamen
H. R. Meahl
J. H. Mennie
P. E. Ohmart
H. W. Parker
S. I. Rambo
W. Richter
W. C. Rudd
E. H. Schulz
C. F. Spitzer
W. R. Thurston
M. P. Vore
J. Weinberger

SUBCOMMITTEES

10.1 Definitions for Induction and Dielectric Heating

C. F. Spitzer, *Chairman*

G. P. Bosomworth
J. M. Gage
J. Dalke
E. Mittelmann
W. Richter

10.2 Dielectric Measurements

J. Dalke, *Chairman*

G. W. Klingaman
H. R. Meahl
J. H. Mennie
F. C. Spitzer

10.4 Methods of Measurement

E. Mittlemann, *Chairman*

J. M. Cage
J. L. Dalke
S. I. Rambo
E. H. Schulz
W. R. Thurston

11. INFORMATION THEORY AND MODULATION SYSTEMS

W. G. Tuller, *Chairman*
J. G. Kreer, Jr., *Vice Chairman*

P. L. Bargellini
W. R. Bennett
L. A. DeRosa
D. D. Grieg
J. V. Harrington
H. W. Kohler
E. R. Kretzmer
V. D. Landon
N. Marchand
L. A. Meacham
W. Palmer
D. Pollack

12. NAVIGATION AIDS

P. C. Sandretto, *Chairman*
H. R. Mimno, *Vice Chairman*

W. B. Burgess
H. Davis
R. E. Gray
H. I. Metz
W. Palmer
L. M. Sherer

SUBCOMMITTEES

12.2 Standard DF Measurements

E. D. Blodgett, *Chairman*
J. Kaplan, *Vice Chairman*
J. L. Allison, *Secretary*
R. Silberstein, *Alternate Secretary*

A. D. Bailey
H. I. Butler
F. M. Kratokvil
A. A. Kunze
J. T. Lawrence
H. R. Mimno
W. M. Richardson
L. M. Harding
J. J. Kelleher
J. A. Solga
J. O. Spriggs
C. A. Strom, Jr.
S. R. Thrift
J. H. Trexler

12.3 Measurement Standards for Navigation Systems

F. Moskowitz, *Chairman*
S. B. Fishbein, *Secretary*

P. Adams
S. Anderson
P. Hansel
M. Leifer
G. Litchford
J. T. MacLemore
P. W. Siglin
V. Weihe

14. PIEZOELECTRIC CRYSTALS

W. P. Mason, *Chairman*
H. Jaffe, *Vice Chairman*

W. G. Cady
J. K. Clapp
W. A. Edson
I. E. Fair
W. D. George
E. Gerber
S. Roberts
P. L. Smith
R. A. Sykes
K. S. Van Dyke

15. RADIO TRANSMITTERS

P. J. Herbst, *Chairman*
H. Goldberg, *Vice Chairman*

J. Battison
M. R. Briggs
H. R. Butler
L. K. Findley
J. B. Heffelfinger
A. E. Kerwien
J. B. Knox
L. A. Looney
J. F. McDonald
J. Ruston
B. Sheffield
I. R. Weir
T. M. Gluyas, Jr.

SUBCOMMITTEES

15.1 FM Transmitters

J. Ruston, *Chairman*

J. Bose
J. R. Boykin
N. Marchand
P. Osborne
H. P. Thomas

15.2 Radio-Telegraph Transmitters up to 50 MC

B. Sheffield, *Chairman*

H. R. Butler
J. L. Finch
J. F. McDonald
F. D. Webster
I. R. Weir

15.3 Double Sideband AM Transmitters

J. B. Heffelfinger, *Chairman*

R. B. Beetham
L. K. Findley
L. A. Looney

15.4 Pulse-Modulated Transmitters

H. Goldberg, *Chairman*

R. Bateman
L. L. Bonham
W. F. Cook
H. Kohler
G. F. Montgomery
A. E. Newlon
W. K. Roberts
B. D. Smith

15.5 Single Sideband Radio Communication Transmitters

A. E. Kerwien, *Chairman*

M. R. Briggs (ex-officio)
A. Brown
J. P. Costas
H. E. Goldstine
L. Kahn
E. A. Laport
J. B. Singel

15.6 Television Broadcast Transmitters

T. M. Gluyas, Jr., *Chairman*

F. J. Bias
E. Bradburd
P. J. Herbst
L. A. Looney
J. Ruston

16. MOBILE COMMUNICATION SYSTEMS

F. T. Budelman, *Chairman*
A. Whitney, *Vice Chairman*

G. M. Brown
A. V. Dasburg
D. B. Harris
C. M. Heiden
C. N. Kimball, Jr.
D. E. Noble
J. C. O'Brien
D. Talley
G. Teommey
R. W. Tuttle

17. RECEIVERS

J. Avins, *Chairman*
J. D. Reid, *Vice Chairman*

K. A. Chittick
L. E. Closson
D. E. Hartnett
K. W. Jarvis
J. K. Johnson
W. R. Koch
C. O. Marsh
I. J. Melman
G. Mountjoy
F. R. Norton
L. Riebman
L. M. Rodgers
S. W. Seeley
R. F. Shea
W. O. Swinyard
F. B. Uphoff
R. S. Yoder

SUBCOMMITTEES

17.3 Single Sideband Receivers

K. Jarvis, *Chairman*

D. E. Norgaard

17.4 Spurious Radiation

R. F. Shea, *Chairman*

E. W. Chapin
K. A. Chittick
H. E. Dinger
A. B. Glenn
W. R. Koch
T. S. Loeser
R. A. Maher
F. L. Pampel
L. M. Rodgers
E. H. Schrot
H. Schwarz
S. W. Seeley
C. G. Seright
W. B. Smith
J. W. Stratman
W. O. Swinyard
H. J. Tyzzer
R. S. Yoder

17.5 Annual Review Material

L. M Harris, *Chairman*

17.8 Task Group to Review I.E.C. Proposal on Standardization of Measurements of Receivers for AM Broadcast Transmissions

W. O. Swinyard, *Chairman*

H. Adler
W. F. Cotter
R. DeCola
J. K. Johnson
C. O. Marsh
E. R. Pfaff
S. C. Spielman
R. Yoder

17.9 Automatic Frequency Control

F. B. Uphoff, *Chairman*

J. R. Locke

19. SOUND RECORDING AND REPRODUCING

A. W. Friend, *Chairman*
L. Thompson, *Vice Chairman*
M. S. Corrington, *Vice Chairman*

S. J. Begun
S. M. Fairchild
R. M. Fraser
C. J. Lebel
J. H. McGuigan
A. P. G. Peterson
H. E. Roys
H. Schecter
C. F. West
R. E. Zenner

SUBCOMMITTEES

19.1 Magnetic Recording

A. P. G. Peterson, *Chairman*

W. H. Erickson
J. H. McGuigan
W. Shepard, Jr.
W. W. Wetzel
R. E. Zenner

19.2 Mechanical Recording

L. Thompson, *Chairman*

W. S. Bachman
S. M. Fairchild
T. Lindenberg
A. R. Morgan
R. C. Moyer
F. W. Roberts
M. S. Royston
R. H. Schlegel
A. S. R. Toby

19.3 Optical Recording

R. M. Fraser, *Chairman*

Price Fish
E. Miller
C. Townsend

Task Group
C.C.I.R. Task Group of IRE Committee 19

H. R. Roys, *Chairman*

W. S. Bachman
R. M. Fraser
A. W. Friend
R. C. Moyer
L. Thompson

21. SYMBOLS

K. E. Anspach, *Chairman*
H. R. Terhune, *Vice Chairman*

F. M. Bailey
A. G. Clavier
W. J. Everts
W. A. Ford
R. T. Haviland
O. T. Laube
C. D. Mitchell
C. Neitzert
M. B. Reed
A. C. Reynolds, Jr.
M. P. Robinson
M. S. Smith
H. P. Westman

SUBCOMMITTEES

21.2 Graphical Symbols for Semiconductors

C. D. Mitchell, *Chairman*

T. R. Finch
R. A. Henle
F. J. Lingel
R. F. Merrithew
W. H. Miller
M. P. Robinson
A. D. Shaw
E. H. Ulm
J. G. Weissman
H. J. Woll

21.3 Subcommittee on Functional Representation of Control, Computing and Switching Equipment

A. C. Reynolds, Jr., *Chairman*

T. G. Cober
C. W. Frank
J. W. Gorgas
H. F. Herbig
G. W. Hobbs
H. P. Kraatz
F. T. Meyer
E. W. Olcutt
J. S. Osborne
S. W. Roberts
F. J. Roehm
G. M. Sokol

21.4 Subcommittee on Abbreviations, Letter Symbols, and Graphical Symbols for Feedback Control Systems

F. M. Bailey, *Chairman*

H. Freeman
V. J. Louden
T. F. Mahoney

21.5 Subcommittee on New Proposals and Special Assignments

M. P. Robinson, *Chairman*

22. TELEVISION SYSTEMS

R. E. Shelby, *Chairman*
R. M. Bowie, *Vice Chairman*

W. F. Bailey
M. W. Baldwin, Jr.
A. H. Brolly
J. E. Brown
K. A. Chittick
C. G. Fick
D. G. Fink
P. C. Goldmark
R. N. Harmon
J. E. Hayes
J. L. Hollis
A. G. Jensen
I. J. Kaar
R. D. Kell
P. J. Larsen
H. T. Lyman
L. Mautner
J. Minter
A. F. Murray
D. W. Pugsley
M. Silver
D. Smith
M. E. Strieby
A. Talamini

SUBCOMMITTEES

22.1 Definitions

M. W. Baldwin, Jr., *Chairman*

A. V. Bedford
J. W. Christensen
S. Helt
C. J. Hirsch
D. L. MacAdam
H. A. Samulon
E. Sieminski
R. E. Waggener
W. T. Wintringham

22.2 Television Picture Element

R. M. Bowie, *Chairman*

W. E. Bradley
S. Helt
M. Leifer
P. Mertz
H. A. Samulon
O. H. Schade

23. VIDEO TECHNIQUES

W. J. Poch, *Chairman*
A. J. Baracket, *Vice Chairman*

S. W. Athey
J. Battison
K. B. Benson
E. M. Coan
S. Doba, Jr.
V. J. Duke
G. L. Fredendall
J. L. Jones
L. L. Lewis
C. G. Pierce
B. F. Tyson

SUBCOMMITTEES

23.2 Utilization, Including Video Recording: Methods of Measurement

R. L. Garman, *Chairman*

S. W. Athey
K. B. Benson
J. M. Brumbaugh
V. J. Duke
G. Gordon
L. D. Grignon
S. Kraemer
H. Milholland
H. J. Schlafly

23.3 Video Systems and Components: Methods of Measurement

A. J. Baracket, *Chairman*

I. C. Abrahams
R. Betts
R. DeBaun
G. L. Fredendall
J. R. Hefele
A. Lind
J. F. Wiggin

23.4 Video Signal Transmission: Methods of Measurement

J. L. Jones, *Chairman*

J. M. Barstow
K. B. Benson
R. D. Chipp
S. Doba, Jr.
L. R. Moffett
R. M. Morris
K. E. Mullenger
R. S. O'Brien
C. A. Rosencrans
E. H. Schreiber
B. F. Tyson

24. WAVE PROPAGATION

N. Smith, *Chairman*

E. W. Allen, Jr.
S. L. Bailey
A. R. Beach
H. G. Booker
C. R. Burrows
T. J. Carroll
A. B. Crawford
A. Earl Cullum, Jr.
W. S. Duttera
R. E. Fontana
I. H. Gerks
M. C. Gray
D. E. Kerr
M. Kline
R. K. Moore
M. G. Morgan
K. A. Norton
H. O. Peterson
G. Sinclair
R. L. Smith-Rose
A. W. Straiton
A. H. Waynick
J. W. Wright
T. A. Wright

SUBCOMMITTEES

24.1 Standards and Practices

H. O. Peterson, *Chairman*

W. S. Duttera
F. M. Greene
G. Sinclair
J. W. Wright

24.2 Theory and Application of Tropospheric Propagation

T. Carroll, *Chairman*

H. G. Booker
A. B. Crawford
M. C. Gray
A. W. Straiton
R. P. Wakeman

24.3 Theory and Application of Ionospheric Propagation

M. G. Morgan, *Chairman*

R. Bateman
K. L. Bowles
R. A. Helliwell
C. W. McLeish
J. H. Meek

24.4 Definitions and Publications

G. Sinclair, *Chairman*

A. B. Crawford
J. E. Eaton
E. G. Fubini
I. H. Gerks
K. Jansky
M. Katzin
D. E. Kerr

24.6 Radio Astronomy

C. R. Burrows, *Chairman*

A. E. Covington
F. T. Haddock, Jr.
J. P. Hagen

25. MEASUREMENTS AND INSTRUMENTATION

F. J. Gaffney, *Chairman*
P. S. Christaldi, *Vice Chairman*

J. L. Dalke
H. Dinger
G. L. Fredendall
W. D. George
W. J. Mayo-Wells
G. A. Morton
C. D. Owens
A. P. G. Peterson
J. G. Reid, Jr.
J. R. Steen

SUBCOMMITTEES

25.1 Basic Standards and Calibration Methods

W. G. George, *Chairman*

S. L. Bailey
G. L. Davies
F. J. Gaffney

25.2 Dielectric Measurements

J. Dalke, *Chairman*

C. A. Bieling
F. A. Muller

25.3 Magnetic Measurements

C. D. Owens, *Chairman*

W. Cairnes
G. S. Fay
P. H. Haas
E. J. Smith

25.4 Audio-Frequency Measurements

A. P. G. Peterson, *Chairman*

R. Grimm
R. A. Long

25.5 Video Frequency Measurements

G. L. Fredendall, *Chairman*

J. Fisher
R. Palmer
H. A. Samulon
W. R. Thurston

25.6 High Frequency Measurements

R. V. Lowman, *Chairman*

R. A. Braden
I. G. Easton
C. J. Franks
F. J. Gaffney
G. B. Hoadley
E. W. Houghton
D. Keim
B. M. Oliver
B. Parzen

25.8 Interference Measurements

H. E. Dinger, *Chairman*

F. H. Dickson
C. W. Frick
F. M. Greene
R. M. Showers
A. H. Sullivan, Jr.

25.9 Measurement of Radio Activity

G. A. Morton, *Chairman*

R. L. Butenhoff
D. L. Collins
L. F. Curtiss
L. W. Davison
F. D. Lewis
A. Lovoff
M. A. Schultz
W. W. Schultz

25.10 Oscillography

P. S. Christaldi, *Chairman*
M. J. Ackerman, *Vice Chairman*

R. R. Batcher
M. E. Clark
E. Durbin
R. Feldt
E. R. Haberland
H. M. Joseph
J. H. Mulligan, Jr.
A. L. Stillwell
H. Vollum

25.11 Statistical Quality Control

J. R. Steen, *Chairman*

J. Dorfman
B. Hecht
R. F. Rollman

25.13 Telemetering

W. J. Mayo-Wells, *Chairman*

J. L. Blackburn
J. F. Brinster
R. E. Colander
A. P. Gruer
R. L. Harding
C. H. Hoeppner
M. V. Kiebert
F. W. Lehan
E. E. Lynch
M. G. Pawley
W. E. Phillips
G. M. Thynell
F. L. Verwiebe
G. F. C. Weedon
W. A. Wildhack

25.14 Electronic Components

J. G. Reid, Jr., *Chairman*

G. B. Devey
J. C. P. Long
J. H. Muncy
A. W. Rodgers
N. H. Taylor
A. E. Zdobysz

26. FEEDBACK CONTROL SYSTEMS

W. M. Pease, *Chairman*

V. B. Haas, Jr.
R. J. Kochenburger
W. K. Linvill
J. C. Lozier
E. A. Sabin
P. Travers
J. E. Ward
R. B. Wilcox
S. B. Williams

SUBCOMMITTEES

26.1 Terminology for Feedback Control Systems

J. C. Lozier, *Chairman*

M. R. Aaron
G. R. Arthur
V. Azgapetian
J. O. Edson
T. Flynn
L. Goldman
C. F. Rehberg
F. Zweig

INSTITUTE REPRESENTATIVES IN COLLEGES—1953*

*Agricultural and Mechanical College of Texas: H. C. Dillingham
*Akron, University of: P. C. Smith
*Alabama Polytechnic Institute: R. M. Steere
*Alberta, University of: J. W. Porteous
*Arizona, University of: H. E. Stewart
*Arkansas, University of: W. W. Cannon
*British Columbia, University of: L. R. Kersey
*Brooklyn, Polytechnic Institute of (Day Division): L. Goldstone
*Brooklyn, Polytechnic Institute of (Evening Division): Appointment later
*Brown University: J. P. Ruina
*Bucknell, University of: George Irland
*California Institute of Technology: J. N. Thurston
*California State Polytechnic College: Clarence Radius
*California, University of: H. J. Scott
California, University of at Los Angeles: E. F. King
Carlton College: G. R. Love
*Carnegie Institute of Technology: G. H. Royer
*Case Institute of Technology: J. D. Johannesen
*Cincinnati, University of: A. B. Bereskin
*Clarkson College of Technology: Joseph Salerno
*Colorado, University of: W. G. Worcester
*Columbia University: Appointment later
*Connecticut, University of: V. B. Haas, Jr.
*Cooper Union: J. B. Sherman
*Cornell University: True McLean
Dartmouth College: M. G. Morgan
*Dayton, University of: Appointment later
*Delaware, University of: H. S. Bueche
*Denver, University of: R. C. Webb
*Detroit, University of: Thomas Yamauchi
*Drexel Institute of Technology: R. T. Zern
Duke University: H. A. Owen
*Fenn College: K. S. Sherman
*Florida, University of: S. P. Sashoff
*George Washington University: W. H. Gossard
*George Institute of Technology: M. A. Honnell
Harvard University: E. L. Chaffee
*Illinois Institute of Technology: R. M. Leger
*Illinois, University of: P. F. Schwarzlose
*Iowa, State University of: L. A. Ware
*Iowa State College: G. A. Richardson
*John Carroll University: J. L. Hunter
*Johns Hopkins University: Ferdinand Hamburger, Jr.
*Kansas State College: J. E. Wolfe
*Kansas, University of: D. G. Wilson
*Kentucky, University of: N. B. Allison

---

* Colleges with approved Student Branches.

*Lafayette College: F. W. Smith
*Lehigh University: D. E. Mode
*Louisiana State University: L. V. McLean
*Louisville, University of: S. T. Fife
*Maine, University of: Appointment later
*Manhattan College: T. P. Canavan
Manitoba, University of: R. G. Anthes
*Marquette University: Appointment later
*Maryland, University of: G. F. Corcoran
*Massachusetts Institute of Technology: E. A. Guillemin, W. H. Radford
Massachusetts, University of: C. S. Roys
McGill University: F. S. Howes
*Miami, University of: F. B. Lucas
*Michigan College of Mining and Technology: R. J. Jones
*Michigan State College: I. O. Ebert
*Michigan, University of: L. N. Holland
*Minnesota, University of: Leroy Anderson
*Mississippi State College: P. T. Hutchison
*Missouri School of Mines and Metallurgy: R. E. Nolte
*Missouri, University of: G. V. Lago
*Montana State College: R. C. Seibel
*Nebraska, University of: Charles Rook
Nevada, University of: I. J. Sandorf
*Newark College of Engineering: D. W. Dickey
*New Hampshire, University of: A. L. Winn
*New Mexico College of Agriculture and Mechanic Arts: H. A. Brown
*New Mexico, University of: J. F. Davis
*New York, College of the City of: Harold Wolf
*New York University: Appointment later
*North Carolina State College: Appointment later
*North Dakota Agricultural College: E. M. Anderson
*North Dakota, University of: Clifford Thomforde
*Northeastern University: G. E. Pihl
*Northwestern University: A. H. Wing, Jr.
*Notre Dame, University of: H. E. Ellithorn
*Ohio State University: R. A. Neubauer
*Ohio University: D. B. Green
*Oklahoma Agricultural and Mechanical College: A. L. Betts
Oklahoma, University of: C. L. Farrar
*Oregon State College: A. L. Albert
*Pennsylvania State College: C. R. Ammerman
*Pennsylvania, University of: D. F. Hunt
*Pittsburgh, University of: John Brinda, Jr.
*Pratt Institute: David Vitrogan
*Princeton University: N. W. Mather
*Purdue University: R. P. Siskind
Queens University: H. H. Stewart
*Rensselaer Polytechnic Institute: H. D. Harris
*Rhode Island, University of: R. S. Haas
Rice Institute: C. R. Wischmeyer
Rose Polytechnic Institute: H. A. Moench
*Rutgers University: J. L. Potter
*St. Louis University: G. E. Dreifke
*San Diego State College: D. C. Kalbfell
*San Jose State College: Harry Engwicht
Santa Clara, University of: H. P. Nettesheim
*Seattle University: Appointment later
*South Carolina, University of: Appointment later
*South Dakota School of Mines and Technology: Appointment later
*Southern California, University of: G. W. Reynolds
*Southern Methodist University: Paul Harton
*Stanford University: H. P. Blanchard
*Stevens Institute of Technology: A. C. Gilmore, Jr.
*Syracuse, University of: Herbert Hellerman
*Tennessee, University of: E. D. Shipley
*Texas, University of: H. W. Smith
*Texas Technological College: Appointment later
*Toledo, University of: R. E. Weeber
*Toronto, University of: George Sinclair
*Tufts College: A. H. Howell
*Tulane University: J. A. Cronvich
United States Naval Post Graduate School: G. R. Giet
*Utah State Agricultural College: Clayton Clark
*Utah, University of: M. E. Van Valkenburg
*Villanova College: Appointment later
*Virginia Polytechnic Institute: R. R. Wright
*Virginia, University of: J. C. Mace
*Washington, University of: H. M. Swarm
*Wayne University: D. V. Stocker
Western Ontario, University of: E. H. Tull and J. H. Blackwell
*West Virginia University: R. C. Colwell
*Wisconsin, University of: Glenn Koehler
Witwatersrand, University of: G. R. Bozzoli
*Worcester Polytechnic Institute: H. H. Newell
*Wyoming, University of: W. M. Mallory
*Yale University: J. G. Skalnik

INSTITUTE REPRESENTATIVES ON OTHER BODIES—1953

Council of the American Association for the Advancement of Science: J. C. Jensen
ASA Standards Council: Axel G. Jensen; Ernst Weber, L. G. Cumming, alternates
ASA Electrical Standards Board: L. G. Cumming, A. G. Jensen, F. B. Llewellyn
ASA Graphic Standards Board: A. F. Pomeroy; A. G. Clavier, alternate
ASA Sectional Committee (C16) on Radio (Sponsored by IRE): S. L. Bailey, Chairman; L. G. Cumming, Secretary; A. G. Jensen, J. Avins
ASA Sectional Committee (C39) on Electrical Measuring Instruments: Wilson Aull, Jr., F. J. Gaffney
ASA Sectional Committee (C42) on Definitions of Electrical Terms: M. W. Baldwin, Jr., A. G. Jensen, Haraden Pratt, J. G. Brainerd
ASA Subcommittee (C42.1) on General Terms: J. G. Brainerd
ASA Subcommittee (C42.6) on Electrical Instruments: Ernst Weber; F. J. Gaffney, alternate
ASA Subcommittee (C42.13) on Communications: J. C. Schelleng
ASA Subcommittee (C42.14) on Electron Tubes: L. S. Nergaard
ASA Sectional Committee (C60) on Standardization on Electron Tubes: L. S. Nergaard, C. E. Fay
ASA Sectional Committee (C61) on Electric and Magnetic Magnitudes and Units: S. A. Schelkunoff, J. W. Horton, E. S. Purington
ASA Sectional Committee (C63) on Radio-Electrical Coordination: John Dalke; D. E. Watts, alternate
ASA Sectional Committee (C67) on Standardization of Voltages—Preferred Voltages—100 Volts and Under: J. R. Steen
ASA Sectional Committee (Y1) on Abbreviations: A. F. Pomeroy; H. R. Terhune, alternate
ASA Sectional Committee (Y10) on Letter Symbols and Abbreviations for Science and Engineering: A. G. Clavier; H. R. Terhune, alternate
ASA Sectional Committee (Y10.14) on Nomenclature for Feedback, Control Systems: W. M. Pease, J. R. Ragazzini, W. A. Lynch
ASA Sectional Committee (Y14) on Standards for Drawing and Drafting Room Practices: Austin Bailey, A. G. Clavier, alternate
ASA Sectional Committee (Y15) on Preferred Practice for the Preparation of Graphs, Charts and Other Technical Illustrations: H. R. Terhune; A. G. Clavier, alternate
ASA Sectional Committee (Y32) on Graphical Symbols and Designations: Austin Bailey; A. F. Pomeroy, alternate
ASA Sectional Committee (Z17) on Preferred Numbers: A. F. Van Dyck
ASA Sectional Committee (Z24) on Acoustical Measurements and Terminology: W. D. Goodale, Jr.; H. F. Olson, alternate
ASA Sectional Committee (Z57) on Sound Recording: H. E. Roys; A. W. Friend, alternate
ASA Sectional Committee (Z58) on Standardization of Optics: E. Dudley Goodale; L. G. Cumming, alternate
Atomic Energy Commission—Policy Committee for Release of Technical Information: Keith Henney
Executive Committee of U. S. Delegation: A. G. Jensen; L. G. Cumming, alternate
International Radio Consultative Committee—
International Scientific Radio Union (URSI) Executive Committee: S. L. Bailey
Joint IRE-AIEE Committee on High Frequency Measurements: R. W. Lowman, R. A. Braden, I. G. Easton, F. J. Gaffney, G. B. Hoadley, H. W. Houghton, B. Parzen, David Y. Keim, C. J. Franks, B. M. Oliver
IRE-AIEE Committee on Noise Definitions: A. W. Friend, R. M. Ryder, S. Goldman, Jerry Mintner, LeRoy Moffett
Joint IRE-AIEE-NEMA Co-ordination Committee on Commercial Induction and Dielectric Heating Apparatus: John Dalke; George P. Bosomworth, alternate
Joint IRE-RTMA-SMPTE-NARTB Committee for Inter-Society Coordination (Television): A. G. Jensen; M. W. Baldwin, alternate
U. S. National Committee, International Electrotechnical Commission, Advisers on Symbols: Austin Bailey; A. F. Pomeroy, alternate
U. S. National Committee, International Electrotechnical Commission, Advisers on Electrical Measuring Instruments: Wilson Aull; F. J. Gaffney, alternate
U. S. National Committee of the International Electrotechnical Commission: F. B. Llewellyn, A. G. Jensen, L. G. Cumming

Abstracts and References

Compiled by the Radio Research Organization of the Department of Scientific and Industrial Research, London, England, and Published by Arrangement with that Department and the *Wireless Engineer*, London, England

NOTE: The Institute of Radio Engineers does not have available copies of the publications mentioned in these pages, nor does it have reprints of the articles abstracted. Correspondence regarding these articles and requests for their procurement should be addressed to the individual publications, not to the IRE.

The index to the Abstracts and References published in the PROC. I.R.E., from February, 1952 through January, 1953, is published by the *Wireless Engineer* and may be purchased for $0.68 (including postage) from the Institute of Radio Engineers, 1 East 79th St., New York 21, N. Y. As supplies are limited, the publishers ask us to stress the need for early application for copies. Included with the Index is a selected list of journals scanned for abstracting with publishers' addresses.

Acoustics and Audio Frequencies....... 818
Antennas and Transmission Lines...... 818
Circuits and Circuit Elements.......... 819
General Physics.................... 821
Geophysical and Extraterrestrial Phenomena........................ 822
Location and Aids to Navigation....... 824
Materials and Subsidiary Techniques... 825
Mathematics....................... 826
Measurements and Test Gear......... 827
Other Applications of Radio and Electronics......................... 828
Propagation of Waves............... 829
Reception.......................... 829
Stations and Communication Systems... 829
Subsidiary Apparatus................ 830
Television and Phototelegraphy........ 830
Transmission....................... 831
Tubes and Thermionics.............. 831
Miscellaneous...................... 832

The number in heavy type at the upper left of each Abstract is its Universal Decimal Classification number and is not to be confused with the Decimal Classification used by the United States National Bureau of Standards. The number in heavy type at the top right is the serial number of the Abstract. DC numbers marked with a dagger (†) must be regarded as provisional.

ACOUSTICS AND AUDIO FREQUENCIES

534:061.4 1218
The 1952 Audio Fair in Review—H. K. Richardson. (*Audio Eng.*, vol. 36, pp. 26–28, 60; Dec. 1952.) Alphabetical list of firms represented, with notes of their exhibits.

534.15 1219
Study and Representation of a Complex Musical Tone—A. Moles. (*Ann. Télécommun.*, vol. 7, pp. 430–438; Nov. 1952.) Discussion of the representation of a complex tone by a 3-dimensional diagram involving the three parameters:—pitch, intensity or level above threshold of audibility, and duration. Analysis of the three projections of the 3-dimensional representation furnishes some rules for coding in the transmission of information representing any particular complex tone. An experimental method of determining the parameters of the 3-dimensional representation is outlined and the application of autocorrelation theory is briefly considered.

534.232 1220
The Absorption Surface of Acoustic Radiators and Radiator Arrays—F. A. Fischer. (*Akust. Beihefte*, No. 1, pp. 7–8; 1951.) The absorption surface of an acoustic radiator of arbitrary size is calculated as a function of wavelength, and its relation to Stenzel's compression factor is demonstrated.

534.232 1221
The Relation between Directivity Characteristic and Amplitude Distribution for Linear and Plane Radiator Systems—F. A. Fischer. (*Akust. Beihefte*, no. 1, pp. 9–11; 1951.) Analysis shows that a given characteristic can be produced by an infinite number of different amplitude distributions.

534.321.9:534.23 1222
Ultrasonic Absorption in Mixtures of Ethyl Alcohol and Water—L. R. O. Storey. (*Proc. Phys. Soc.*, vol. 65, pp. 943–950; Dec. 1, 1952.) Report of measurements using a pulse method, with operating frequencies of 22.5, 37.5 and 52.5 mc and temperatures of 0°, 10° and 25°C. Results are discussed in relation to the theory of the absorption mechanism.

534.321.9:534.6 1223
Interferometer Arrangements for the Detection of Ultrasonic Waves—C. Rossetti. (*Comp. Rend. Acad. Sci.* (*Paris*), vol. 235, pp. 1484–1486; Dec. 10, 1952.) Results of experiments are noted on the generation of standing waves by reflection in a gas column excited by a crystal X_1 oscillating at about 1 mc. When the reflecting surface is a crystal X_2, similar to X_1 and coupled electrostatically to it, the distance between X_1 and X_2 for successive voltage minima across X_2 is a multiple of λ. In air, minima are sharply defined; in CO_2, which has high absorption, the response of X_2 as a function of displacement is roughly sinusoidal.

534.321.9:534.614 1224
Measurement of the Temperature Dependence of the Velocity of Sound in Light and Heavy water and in Mixtures of Water and Ethyl Alcohol—P. P. Heusinger. (*Akust. Beihefte*, no. 1, pp. 3–6; 1951.) A modification of the fixed-path ultrasonic interferometer method of Bender (443 of 1941) is used in which no thermostat is required. Results are shown in graphs.

534.321.9:534.614 1225
A Method for Determining the Velocity of Ultrasonic Waves in Solids—N. F. Otpushchennikov. (*Zh. eksp. teor. Fiz.*, vol. 22, pp. 436–439; April 1952.) A method is proposed based on Rayleigh's law for determining the coefficient of reflection of a sound wave incident normally on a nonabsorbing plate. Using this method, the velocity of ultrasonic waves of frequency 3.3 mc was determined for Al, Mg, glass, methyl methacrylate and ebonite.

534.41 1226
A Development of the Tone-Pitch Recorder having Applications to Phonetics Research—W. Kallenbach. (*Akust. Beihefte*, no. 1, pp. 37–42; 1951.) A modification of the arrangement described by Grützmacher & Lottermoser (590 of 1938) enables vowels and consonants to be distinguished by their effect on the intensity of the beam in the cr tube.

534.442.2 1227
Frequency Analyser with Mechanical High-Frequency Filter—K. Tamm and I. Pritsching. (*Akust. Beihefte*, no. 1, pp. 42–48; 1951.) A heterodyne analyzer is described incorporating a filter consisting of two coupled steel resonators giving a pass band of width 15 cps at 40 kc and capable of discriminating between frequency components separated by as little as 25 cps and differing in level by 40 db. Analysis
over the frequency range 0–20 kc can be e
fected in 150 sec by use of the automatic drive

534.61 122
**Multiple-Rayleigh-Disk Mesh Arrange
ment for Increasing Measurement Sensitivit**
—L. Keidel. (*Akust. Beihefte*, no. 1, pp. 34–3
1951.)

534.75 122
**Contribution to a Scientific Theory c
Single-Channel Transmission of Sound**—
P. Burkowitz. *Funk u. Ton*, vol. 6, pp. 561
580; Nov. 1952.) Relations between the phys
cal, physiological and psychological aspects c
the problem are investigated. See also 2419 c
1952.

***N*621.395.616 123**
New High-Grade Condenser Microphone
—F. W. O. Bauch. (*Wireless World*, vol. 5
pp. 50–54 and 111–114; Feb. & March 1953
Description of the Type-M49 and Type-M5
microphones [see also 893 of 1952 (Grosskopf
and of the Type-U47, a gradient micropho
offering the choice of cardioid or omnidire
tional characteristics.

ANTENNAS AND TRANSMISSION LINE

621.392.26 123
**The Visual Observation and Photographi
of the Radiation from Waveguides**—D.
Penner. (*Comp. Rend. Acad. Sci.* (*U.R.S.S.*
vol. 81, pp. 819–820; Dec. 11, 1951. In Ru
sian.) The waveguide is excited by means of
vibrator with spark-discharge gap, and th
field pattern is made visible by use of met
powders.

621.392.26:538.614 123
Faraday Rotation of Guided Waves—
Suhl and L. R. Walker. (*Phys. Rev.*, vol. 8
p. 1435; Dec. 15, 1952.) Correction to pap
noted in 2710 of 1952.

621.396.6:621.392.21.029.64 123
Manufacture of Microstrip—(See 1269.)

621.396.67 123
Folded Dipoles of Two or More Elements
R. Guertler. (Proc. I.R.E. (Australia), vol. 1
pp. 389–392; Nov. 1952.) Formulas previous
derived (556 of 1950) are developed to give t
impedance transformation of folded dipol
having two, three or four elements. Desi
charts based on the formulas are presented.

621.396.67 12
**The Input Impedance of Thick Cylindric
Aerials**—H. W Ehrenspeck. (*Fernmeldete
Z.*, vol. 5, pp. 497–501; Nov. 1952.) The resu
of measurements of the complex input i
pedance of thick vertical aerials are present
in curves, and a general diagram is deduc
which gives the complex input impedance
any length of aerial, the reduction factor f

λ/4 and λ/2 resonance, the mean characteristic impedance and the wide-band properties of cylindrical aerials of diameter from 0.01 λ to 0.17 λ. Numerical values are determined for a λ/2 aerial of diameter 2 cm for λ=40 cm.

621.396.67:621.397.6 1236

High-Gain Loop Antenna for Television Broadcasting—A. G. Kandoian, R. A. Felsenheld and W. Sichak. (*Elect. Commun.*, vol. 29, pp. 268–277; Dec. 1952. *Tele-Tech*, vol. 11, pp. 42–44, 132; Nov. 1952.) An extension of a previous design (1209 of 1952) for the 174–216-mc band whereby 16 elements, each comprising three folded dipoles, are stacked one above another on an 80-ft lattice structure. "Isolation" rings around the mast reduce the coupling effect between adjacent pairs of elements. A diplexing unit is described and performance characteristics are discussed. Power gain relative to a λ/2 dipole is 17.

621.396.67:621.397.62 1237

Receiving Aerials for British Television—F. R. W. Strafford. (*Proc. IEE* (*London*), Part IIIA, vol. 99, pp. 631–642. Discussion, pp. 645–650; 1952.) Six different methods of analysis are considered; the proximity of an aerial to the earth and the presence of the necessary feeder render agreement between experimental measurements and calculations based on any of the theories rather fortuitous. The properties of 2-element and 4-element arrays are discussed and also indoor aerials. The problem of ghost images due to multipath propagation, and difficulties of reception in hilly country, where the image due to reflection may be stronger than the direct-transmission image, are briefly considered. Mechanical design is also treated.

621.396.67.001.11 1238

On the Calculation of Some Definite Integrals in Antenna Theory—H. L. Knudsen. (*Appl. Sci. Res.*, vol. B3, pp. 51–68; 1952.) If the expression for the mutual radiation resistance obtained by the Poynting vector method (32 of January) for two identical linear aerials is equated to that obtained by the EMF method, a useful formula may be obtained which expresses a definite integral in terms of known functions. An outline of this procedure is given for the simple cases of two parallel and two collinear identical aerials.

621.396.67.018.424 1239

Experimentally Determined Radiation Characteristics of Conical and Triangular Antennas—G. H. Brown and O. M. Woodward, Jr. (*RCA Rev.*, vol. 13, pp. 425–452; Dec. 1952.) Impedance and radiation measurements, mostly at 500 mc, were made on conical and triangular aerials constructed of copper-plated sheet steel. For various flare angles and aerial engths, graphs of resistance, reactance and relative field strength are given, and the power gain relative to a λ/2 dipole is calculated. Measurement results agree reasonably well with values calculated by Papas & King (1307 of 1951).

621.396.677+621.385.029.6 1240

Attenuation of Wire Helices in Dielectric Supports—Peter, Ruetz and Olson. (See 1523.)

621.396.677 1241

Factors Affecting the Performance of Linear Arrays—L. L. Bailin and M. J. Ehrlich. (Proc. .R.E., vol. 41, pp. 235–241; Feb. 1953.) Discussion mainly of the deterioration of side-lobe evel due to variations in the excitation of the ndividual elements of an array arising from manufacturing inaccuracies. Analysis is presented for three 24-element linear shunt-slot arrays using a Dolph-Tchebycheff distribution or the element excitations [2487 of 1946 (Dolph)], the arrays being designed for the *X* and, with side lobes 20, 30 and 40 db down respectively.

621.396.677 1242

Electromagnetic Horn Radiators with Phase-Correcting Microwave Lenses—K. Hurrle. (*Arch. elekt. Übertragung*, vol. 6, pp. 502–506; Dec. 1952.) Experiments are reported on a pyramidal horn having a flare angle of 32° and a mouth 64 cm×64 cm with a circular opening of diameter 55 cm. Measurements were made on a wavelength of 6.1 cm, (*a*) without phase correction, (*b*) with a delay lens made of metal louvres in the opening, (*c*) with a paraffin lens. The radiation patterns obtained clearly show the improvements in gain and directivity due to the phase correction.

621.396.677 1243

A Theoretical Study of an Antenna-Reflector Problem—W. C. Jakes, Jr. (Proc. I.R.E., vol. 41, pp. 272–274; Feb. 1953.) Discussion of systems used at microwave relay stations in which an antenna with circular aperture, facing upwards, receives incoming energy from a plane reflector immediately above it and inclined at 45°. Analysis shows that for certain values of λ, distance between antenna and reflector, aerial aperture and size of reflector, the received power is greater than when the antenna is used alone in the position of the reflector. See also 936 of April (Unger).

621.396.677:537.226 1244

Longitudinal Radiation of Dielectric Aerials—J. C. Simon and G. Weill. (*Comp. Rend. Acad. Sci.* (*Paris*), vol. 235, pp. 1379–1381; Dec. 1, 1952.) A calculation is made of the field at infinity and the total radiated power for the simple case of a plane wave crossing a boundary between media of different refractive indices. The results are applied to determine the radiation from a dielectric-rod antenna as a function of the phase velocity of the field along the antenna. The calculated results have been verified experimentally.

621.396.677:621.396.9 1245

Parabolic Aerial with Rotating Beam—G. von Trentini. (*Rev. Telegr. Electronica* (*Buenos Aires*), vol. 41, pp. 579–581; Sept. 1952.) A radar antenna system for operation at a wavelength of 3.21 cm comprises a parabolic Al reflector of diameter 40 cm and focal length 17.8 cm with a brass disk of 9 cm diameter arranged 18.1 cm in front of the vertex of the parabola. Energy is fed through a rotating circular waveguide projecting through the parabola and inclined at a small angle to the axis. Measurements on the system are reported.

621.396.677.029.64 1246

An Experiment on a Plane Microwave Diffraction Grating—L. Grillini. (*Nuovo Cim.*, vol. 8, pp. 952–959; Dec. 1, 1951. Observations of the Fraunhofer pattern are reported for a metal-strip grating, using a wavelength of 3.2 cm. Results are substantially different for the cases of electric vector respectively parallel to or perpendicular to the strips.

CIRCUITS AND CIRCUIT ELEMENTS

621.3.015.3 1247

Initial Conditions in Transient Analysis—L. Tasny-Tschiassny. (*Wireless Eng.*, vol. 30, pp. 28–31; Feb. 1953.)In a paper on network theory (37 of 1946) Lee & MacDonald indicated the equivalence of a charged capacitor and the series combination of an uncharged capacitor and a battery; extension of this idea to consideration of inductors leads to a simple method of analyzing initial conditions. The method is elucidated by two theorems and examples; the Laplace-transform treatment is used.

621.3.015.3:621.392 1248

Transient Conditions—P. Poincelot. (*Comp. Rend. Acad. Sci.* (*Paris*), vol. 235, pp. 1492–1494; Dec. 10, 1952.) By transformation of the Fourier integrals to obtain a series development of Bessel functions, expressions have been derived for certain transient-response characteristics. These include the response of a low-pass and a high-pass *LC* ladder filter, and of a homogeneous transmission line, to unit-step and sinusoidal voltage input, when the system is terminated by its image impedance.

621.3.018.78 1249

Reduction of Carrier-Frequency Build-Up Process to a Complex Low-Frequency Process—J. Peters. (*Arch. elekt. Übertragung*, vol. 6, pp. 513–514; Dec. 1952.) The Laplace-transform method is used. By applying the displacement law, the distortion of a carrier envelope due to a linear transmission element can be calculated directly. Vestigial as well as symmetrical sideband systems can be dealt with in this way.

621.314.22.015.7 1250

A Turns Index for Pulse-Transformer Design—H. W. Lord. (*Elect. Eng. N. Y.*, vol. 71, p. 978; Nov. 1952.) Summary only. By assuming certain ratios between core and coil dimensions which represent average values of normal practical designs, it is found possible to generalize design relations so that coil and core dimensions are eliminated from first-design considerations, the only parameter remaining being that of the turns of the windings. For a step-up pulse transformer of ratio $>3:1$, a formula is given for the number of turns on the secondary in terms of performance requirements and properties of the dielectric and magnetic materials used. The formula was checked against actual values for existing transformers covering a range of pulse widths from 0.05 to 10 μs and secondary voltages from 15 to 100 kV.

621.314.3† 1251

A Mathematical Analysis of an Inductively Loaded Parallel-Connected Magnetic Amplifier—L. A. Pipes. (*Jour. Appl. Phys.*, vol. 23, pp. 1358–1361; Dec. 1952.)

621.316.543.2:621.392.26 1252

A Multichannel Switch for Operation in a Microwave Circuit—H. M. Barlow and H. G. Effemey. (*Jour. Sci. Instr.*, vol. 29, pp. 378–379; Nov. 1952.) Description of a rotating-disk type of switch for CRO display of a rapid succession of pulses picked up by a number of probes arranged at different points along a waveguide passing 3-kmc signals.

621.316.8 1253

E-C Glass Resistors—J. K. Davis. (*Tele-Tech*, vol. 11, pp. 55, 120; Nov. 1952.) Discussion of performance characteristics of highly stable resistors consisting of a thin conductive coating on heat-resistant glass. Ratings range from ½ W to 45 W. Resistance change is $<0.2\%$ for temperature cycles between −55° and +200°C.

621.318.435.3 1254

The Design of Single-Phase Transductors—H. A. Ross. (*Jour. Appl. Sci.* (*Australia*), vol. 3, pp. 277–292; Dec. 1952.)

621.318.57 1255

A Ferromagnetic Scaling Circuit—C. H. Hertz. (*Ark. Fys.*, vol. 5, parts 1/2, pp. 141–161; Aug. 23, 1952.) Each incoming pulse triggers the discharge of a capacitor through the primary coil on an iron-wire core. The maximum voltage of the pulse induced in the secondary depends on the core magnetization, and thus on the number of incoming pulses. On reaching a preselected level, a thyratron is fired and operates a mechanical counter, the core being restored to its initial state of magnetization. Scales of up to 10:1 are stable in operation. Design details and theory are discussed.

621.318.572 1256

Gated Decade Counter requires No Feedback—E. L. Kemp. (*Electronics*, vol. 26, pp. 145–147; Feb. 1953.) Decade counting is achieved in a system using binary-type counting circuits by arranging that eight pulses are directed into one storage circuit and the next two pulses into a second storage circuit, after which the system resets itself.

621.318.572:621.3.015.7 1257

Counting Pulses of Various Forms and Occurrence Intervals by Electronic Counters—N. F. Roberts and L. T. Wilson. (*Jour. Appl. Sci.* (*Australia*), vol. 3, pp. 263–176; Dec. 1952.) Modifications to univibrator circuits are described which prevent retriggering during the recovery period, or provide a retriggering characteristic permitting the recording of overlapping pulses, or both.

621.392.4/.5 1258

Maximum Power in Termination Impedors—M. Skalicky. (*Elektrotech. u. Maschinenb.*, vol. 69, pp. 479–480; Nov. 1, 1952.) An analytical proof that power is a maximum when the resistive component of the load is equal to the internal resistance of the source, and the reactive components cancel out. The principle can be extended to the case of a quadripole by reformulating the Helmholtz equations.

621.392.41 1259

The Power of Nonsinusoidal Systems—E. Astuni. (*Ricerca Sci.*, vol. 22, pp. 2139–2147; Nov. 1952.) A calculation is made of the instantaneous power absorbed by a series *LRC* circuit with a nonsinusoidal periodic applied voltage. The square of the apparent power is the sum of the squares of all the component powers for all the harmonics, including so-called "mutual" terms involving harmonics of different order.

621.392.43:621.392.26:621.315.212 1260

The Optimum Piston Position for Wide-Band Coaxial-to-Waveguide Transducers—W. W. Mumford. (Proc. I.R.E., vol. 41, pp. 256–261; Feb. 1953.) Matching of a coaxial line to a waveguide can be effected by means of a probe located ahead of a short-circuiting piston in the waveguide. Matching can usually be achieved by varying any two of the following dimensions: (*a*) off-center distance of the probe, (*b*) probe length, (*c*) distance from piston to probe. As there is, theoretically, an optimum piston position giving greatest bandwidth, it is convenient to vary dimensions (*a*) and (*b*). Experimental results are quoted which corroborate the theory. Bandwidths $> \pm 10\%$ to the 1 db SWR points were obtained.

621.392.5 1261

A Highly Stable Variable Time-Delay System—Y. P. Yu. (Proc. I.R.E., vol. 41, pp. 228–235; Feb. 1953.) Description, with detailed circuit diagrams, of delay systems in which distributed amplification is used to compensate the losses in the linear delay elements. Time jitter is extremely low. Two practical circuits have maximum delays of 12 μs (1 μs per step) and 88 μs (4 μs per step) respectively.

621.392.5 1262

Theory of the Compensated Delay Line—R. Ascoli. (*Nuovo Cim.*, vol. 8, pp. 914–927; Dec. 1951.) Analysis based on an equivalent ladder network indicates that for a certain compensating capacitance a constant delay can be obtained over a predetermined frequency range. Calculations are made for compensating rectangular-plate capacitors; results are presented in a graph useful for design. The results are in good agreement with those of Kallmann (41 of 1947) and others.

621.392.5 1263

Synthesis of 2-Terminal-Pair Networks—R. Kahal. (*Elect. Eng.* (*N. Y.*), vol. 71, p. 1014; Nov. 1952.) Summary only. To realize a quadripole ladder network comprising only reactive elements and with prescribed transfer function, five general conditions must be satisfied. These are discussed with particular reference to the synthesis of a ladder network consisting of a number of *L* sections in cascade, all the sections except one comprising only inductors and capacitors. A simple method of completely determining the transfer function of such a network is outlined.

621.392.5 1264

Four-Terminal Networks—O. P. D. Cutteridge. (*Wireless Eng.*, vol. 30, pp. 61–69; March 1953.) A rigorous theory of passive quadripoles in the steady state is presented. The general quadripole is regarded as consisting of *n* meshes, and the equations for the system as a whole are obtained by solving the equations for the meshes. Iterative and image impedances are obtained as properties of a single quadripole, and a suitable propagation function is associated with each pair of impedances. Conditions in quadripoles in two types of cascade arrangement can be deduced immediately from the equations for a single quadripole. Tables are included giving expressions for the image functions in terms of the iterative functions, and vice versa, and giving the equations of the quadripole in terms of the iterative and image functions.

621.392.5.029.64:538.614 1265

New Linear Passive Nonreciprocal Microwave Circuit Component—L. Goldstein and M. A. Lampert. (Proc. I.R.E., vol. 41, pp. 295–296; Feb. 1953.) A note calling attention to the fact that the magneto-optic element producing the Faraday rotations previously reported by Goldstein et al. (2911 of 1951 and 914 of 1952) constitutes a network element of the Tellegen "gyrator" type. See also 1233 of 1952 (Hogan).

621.392.51 1266

A Theorem on Ideal Transformer Networks—É. Achard. (*Ann. Radioélect.*, vol. 7, pp. 237–251; Oct. 1952.) By applying the principle of duality to an impedance-inversion network a general theorem on ideal transformation of voltage, current, and both voltage and current is derived. Provided the resistive components of reactors are sufficiently small, the theorem may be applied in designing networks which can be tuned by a single control (*a*) through a range of frequencies with fixed transformation ratio, (*b*) to give a variable transformation ratio at a fixed frequency.

621.392.52 1267

Exact Amplitude/Frequency Characteristics of Ladder Networks—E. Green. (*Marconi Rev.*, vol. 16, pp. 25–68; 1st Quarter 1953.) A basic theory of the low-pass ladder network is developed on similar lines to Dishal's treatment (3369 of 1949). The theory can be applied by well-known analogies to the derived band-pass, high-pass and band-stop filters. Two types of desired frequency response curves are considered, the Butterworth and Tchebycheff types; general solutions are obtained for both. The results are applied to many practical problems, including the use of networks for coupling a tube to a resistive load or to another tube, power/bandwidth and gain/bandwidth curves being determined for particular cases. Impedance matching between a generator and its load is also considered and matching networks are designed. Examples are also given of the design of low-pass and band-pass filters with either the Butterworth or the Tchebycheff type of response, many useful design curves being given.

621.392.52.072.6 1268

Alignment and Adjustment of Synchronously Tuned Multiple-Resonant-Circuit Filters—M. Dishal. (*Elect. Commun.*, vol. 29, p. 292; Dec. 1952.) Addendum to article noted in 3038 of 1952.

621.396.6:621.392.21.029.64 1269

Manufacture of Microstrip—(*Elec. Commun.*, vol. 29, pp. 250–259; Dec. 1952.) Illustrated description of processes in the manufacture of microstrip components. See also 62 (Grieg & Engelmann), 622 (Assadourian Rimai) and 623 (Kostriza) of March.

621.396.611.1 127

Automodulation in Ferroresonance—A. E Salomonovich. (*Zh. tekh. Fiz.*, vol. 22, pp. 245 258; Feb. 1952.) Automodulation of force oscillations in ferroresonant circuits, IE circuit containing nonlinear reactive elements, is considered. The following examples are examined (*a*) circuit with a thermistor; (*b*) circuit with capacitor whose value depends on the field an on temperature; (*c*) an e.s. voltmeter connecte to a ferroresonant circuit. The stationar operating conditions and their stability in suc circuits are discussed, and the depth and perio of automodulation are determined. The discussion is limited to cases in which the circuit i nearly of the linear conservative type and th variations of amplitude and phase are slow i comparison with the period of the externa force.

621.396.611.1:621.3.016.352 127

A Criterion of Stability for Oscillations i *n*-Mesh Networks with Varying Parameters—W. Haacke. (*Arch. elekt. Übertragung*, vol. 6 pp. 515–519; Dec. 1952.) Analysis given previously (2470 of 1952) is generalized to apply t any network in which some or all of the capacitances or inductances vary periodically. Conditions necessary for the growth of free oscillations having small initial amplitudes are investigated. The system is represented by a determinant equation from whose roots the stability conditions are derived.

621.396.611.1.029.62/.63]:621.392.21 1272

Fixed-Length Transmission Lines as Circuit Elements—A. A. Meyerhoff and R Graham, Jr. (Proc. I.R.E., vol. 41, pp. 262–268; Feb. 1953.) Resonant systems consistin of fixed-length transmission lines with a capacitor at each end have decided advantages, compared with short-circuited transmission-lin sections, for use at frequencies of the order o 50-500 mc. Analysis is presented which leads t simple graphical determination of the line an capacitor parameters. The analysis is extende to include interstage coupling circuits and wide band coupling of an aerial to the output stage o a transmitter. Numerical examples are given.

621.396.611.21 1273

The Measure of Activity for Oscillatin Quartz Crystals in Parallel-Resonance Circuit—H. Awender and K. Sann. (*Telefunken Ztg.* vol. 25, pp. 269–274; Nov. 1952.) The concep of "performance index" is explained. This is th effective parallel resistance R_{pq} of the resonan crystal shunted by a specified capacitance. method of measurement of R_{pq} is described Load-current density should be specified whe quoting R_{pq}.

621.396.611.21:621.3.016.352 127

The Stability of Quartz Oscillators—E Kettel. (*Telefunken Ztg.*, vol. 25, pp. 246–256 Nov. 1952.) Supposing a series-connected crystal in a resonant *LC* circuit to be short-circuited, the relative detuning *F* due to the presence of the crystal is termed the stabilizatio factor. Different arrangements of Meissne Hartley and Colpitts circuits are considered The most stable circuit is one in which *F* is maximum compatible with oscillation and i independent of (*a*) change in the valve inte electrode capacitance and (*b*) the load curren through the crystal. The properties of a circu in which the crystal acts as an inductance a similar in all respects to those of a circuit wit the crystal operating at series resonance.

621.396.611.21:621.3.016.352 127

Methods for Improving the Frequency Stability of Transmitters—Herzog. (See 1513.)

621.396.611.3 127

Equations for the Natural Frequencies Coupled Circuits from the Quadripole View

nt: Part 2—H. Rukop. (*Telefunken Ztg.*, . 25, pp. 216–228; Nov. 1952.) Theory previ- sly given (78 of 1952) is extended to the case a six-terminal network with both series- and rallel-connected resistance. The biquadratic ıation for a coupled system is expressed by o binomials, one referring to the circuits un- ıpled, the other "occupation" binomial tak- ; account of the coupling data. Two schemes formulating this "occupation" factor and ociated expressions probably cover all cases coupling by a single resistor.

1.396.611.3:621.396.619.13 **1277**
Quartz-Crystal Circuit with Variable Cou- ng as Oscillator and Discriminator—E. ttel. (*Telefunken Ztg.*, vol. 25, pp. 265–269; v. 1952.) The principle of the AM oscillator scribed is the use of two coupled tuned cir- ts, the second of which has a crystal con- ted in parallel. A reactance tube drives the illator tube, which has the first circuit con- ted between anode and a capacitor con- ted to the grid, with anode feed to the ıter-tap on the inductor. The relative fre- ency swing attainable is from 1 to 10 parts in . Impedance diagrams for the circuit are wn. The principle is also applied in a dis- minator in which the center-tap of the sec- l-circuit inductor is connected through a ge-value capacitor to the anode side of the t circuit, the coupling between the inductors ng variable. The center frequency of this criminator is largely independent of the aracteristics of the rectifying diodes.

1.396.615 **1278**
Wien-Bridge Oscillator Design—K. K. arke. (Proc. I.R.E., vol. 41, pp. 246–249; b. 1953.) A set of curves is presented which ows direct determination of design parame- s of Wien-bridge oscillators and selective ıplifiers.

1.396.615 **1279**
Perturbations of Filtered Oscillators—G. hen. (*Comp. Rend. Acad. Sci.* (*Paris*), vol. 5, no. 25, pp. 1614–1617; Dec. 22, 1952.) The ıplifier of an oscillator is assumed to be fil- ed to isolate the fundamental frequency, so at the oscillator responds to excitation by a nchronous sinusoidal oscillation. An equation the oscillator perturbations is developed ich involves the partial derivatives of the in and phase. From this equation, the exist- ce of a synchronization threshold can be monstrated for the general case. When the rturbation is below this threshold, frequency lling occurs.

1.396.615:621.316.726.078 **1280**
The Lock-In Performance of an AFC Cir- it—G. W. Preston and J. C. Tellier. (Proc. R.E., vol. 41, pp. 249–251; Feb. 1953.) For e case of *RC* coupling between phase detector d reactance tube in an *AFC* system, an ex- cit relation is derived which determines the k-in condition in an *AFC* system using a ıctance-valve-controlled oscillator. The rela- n involves the filter time-constant, the tial frequency error, the phase-detector con- ınt, and the sensitivity of the oscillator.

1.396.615.18 **1281**
Analysis and Performance of Locked-Oscil- or Frequency Dividers employing Nonlinear ements—W. L. Hughes. (Proc. I.R.E., vol. , pp. 241–245; Feb. 1953.) Locked-oscillator quency dividers can be stabilized by insert- certain nonlinear elements in the oscillator cuits. These elements should have a charac- istic such that the voltage is proportional to integral root of the current through them. If s condition is satisfied, the locked-oscillator ider is almost completely insensitive to wide anges of anode voltage, driving-signal volt- e, and driving frequency. The mathematical oresentation of the nonlinearity of the ele- nts permits some analysis of the circuit non- ear differential equations. Thyrite elements or varistors were used in experimental circuits for division by 3, 5, 7 or 9.

621.396.619.13/.14]:621.3.018.78 **1282**
Calculation of the Harmonic Distortion in Sinusoidal Modulation of Frequency or Phase. Detailed Study of a Quadripole with Anti-resonant Circuit—L. Robin. (*Ann. Télécommun.*, vol. 7, pp. 459–465; Nov. 1952.) The AM voltage, applied to the input terminals of an arbitrary quadripole, is expressed by a convergent Fourier series. An expression is deduced for the tangent of the variable phase shift introduced by the quadripole, in the form of the quotient of two rapidly convergent series of Bessel functions which lend themselves well to numerical calculation. Three parameters are involved: the wavelength λ, the modulation index m, and the ratio μ of λ_0 to the Q factor of the parallel *RLC* circuit considered. Numerical calculations are made for eight cases of practical interest involving different values of μ, m and λ. The results given by the complete formulae for the harmonic distortion are compared with those obtained by application of the "instantaneous frequency" rule.

621.396.64:621.315.612.4 **1283**
A Ferroelectric Amplifier—H. Urkowitz. (*J. Franklin Inst.*, vol. 254, pp. 517–530; Dec. 1952.) A l.F. signal was applied to a capacitor with (Ba-Sr) TiO$_3$-ceramic dielectric, thereby causing its capacitance to vary. The capacitor formed part of a tuned circuit fed by a HF voltage. The resulting AM HF voltage was applied to a detector circuit to recover the signal. Analysis for this arrangement indicates the conditions for maximum amplification. With a signal frequency of 17.6 kc, HF of 2.06 mc and load-resistance 20.8 kΩ, a power gain of 62 was obtained. With the signal source removed and the output fed back to the input terminals, sustained l.F. oscillations were obtained with only the HF voltage applied. The oscillation frequency could be varied continuously from 20.8 to 32 kc by varying the value of a RF choke in the input lead and of a capacitor in the detector circuit. See also 1561 of 1952 (Vincent).

621.396.645 **1284**
Distributed Amplifiers, Mutual-Inductance-Coupled Type—B. Murphy. (*Wireless Eng.*, vol. 30, pp. 39–47; Feb. 1953.) Design procedure is outlined, the problems of output voltage and output matching being considered in detail. A method involving over-running the tubes is described for increasing gain and output, while maintaining the time delay constant, when amplifying random pulses. Details are given of the construction and performance of two amplifiers having a useful bandwidth of 100 mc.

621.396.645 **1285**
Cathode-Follower Operation—H. H. Adelaar. (*Wireless Eng.*, vol. 30, p. 49; Feb. 1953.) Comment on 2481 of 1952 (Shimmins).

621.396.645 **1286**
***RC* or Direct-Coupled Power Stage**—E. F. Good. (*Wireless Eng.*, vol. 30, pp. 54–57; March 1953.) Analysis is performed for an *RC*- or direct-coupled output stage consisting of an ideal triode of resistance r_a, anode feed resistance R_D and load resistance R_L, to determine the relations between r_a, R_D and R_L for maximum efficiency. The formula derived is evaluated for some particular cases.

621.396.645:621.314.7 **1287**
Transistor Circuits—W. Herzog. (*Arch. elekt. Übertragung*, vol. 6, pp. 499–501; Dec. 1952.) By appropriate use of transformers, transistor circuits having characteristics similar to those of ordinary tubes can be obtained. Calculations are given for several particular cases

621.396.822:621.396.645:621.314.7 **1288**
Noise in Transistor Amplifiers—E. Keonjian and J. S. Schaffner. (*Electronics*, vol. 26, pp. 104–107; Feb. 1953.) Conditions for obtaining optimum signal/noise ratio are indicated for amplifiers using point-contact and junction-type transistors. Graphs show the dependence of noise figure on operating point and, for a two-stage amplifier, on the source impedance of the second stage. See also 887 of March and 643 of March (Montgomery).

GENERAL PHYSICS

530.145:51 **1289**
Mathematical Aspects of the Quantum Theory of Fields: Part 3—Boson Field in Interaction with a Given Source Distribution—K. O. Friedrichs. (*Commun. Pure Appl. Math.*, vol. 5, pp. 1–56; Feb. 1952.) Parts 1 and 2: 644 of 1952.

530.145:51 **1290**
Mathematical Aspects of the Quantum Theory of Fields: Part 4—Occupation Number Representation and Fields of Different Kinds—K. O. Friedrichs. (*Commun. Pure Appl. Math.*, vol. 5, pp. 349–411; Nov. 1952.) Part 3: 1289 above.

531.51:537/538 **1291**
Gravitation and Electrodynamics—B. Kursunoglu. (*Phys. Rev.*, vol. 88, pp. 1369–1379; Dec. 15, 1952.) A modification of Einstein's unified field theory is proposed and its physical implications are examined.

535.1:537.228 **1292**
Further Experimental Investigations on the Nature of Light—J. Stark. (*Z. Phys.*, vol. 133, pp. 504–512; Nov. 4, 1952.) Experimental arrangements are described for obtaining (*a*) a photographic record of the effect of a strong nonuniform electric field on a light beam, (*b*) a photometric record of the variation in diffraction due to such a field. The deviation of the beam which occurs when the plane of polarization is perpendicular to the direction of the field is discussed in relation to the EM theory of light.

535.42:538.56 **1293**
Diffraction of Electromagnetic Waves by an Aperture in an Infinite Screen—G. Bekefi. (*Jour. Appl. Phys.*, vol. 23, p. 1403, Dec. 1952.) An approximate solution is derived for conditions of normal incidence on a perfectly conducting screen. The method is applicable where the aperture is large compared with λ, and reduces the problem to one of scalar boundary values.

535.42:538.56 **1294**
Diffraction Field of a Circular Aperture—G. A. Woonton. (*Jour. Appl. Phys.*, vol. 23, pp. 1405–1406; Dec. 1952.) An equation expressing the diffracted field is derived for the case of a normally incident plane wave and a perfectly reflecting screen. The equation is of the form given by Stratton (1819 of 1941) but is modified to agree with certain theoretically and experimentally established conditions.

535.42:538.56 **1295**
A New Method of Solving Diffraction Problems—H. E. J. Neugebauer. (*Jour. Appl. Phys.*, vol. 23, p. 1406; Dec. 1952.) A double-approximation method is indicated for dealing with various problems on the diffraction of EM waves.

535.42:538.566.029.64 **1296**
Application of the Methods of Optics to Calculations of Diffraction Phenomena in the Centimetre-Wave Range—H. Severin. (*Tech. Mitt. schweiz. Telegr.-TelephVerw.*, vol. 30, pp. 347–356; Nov. 1, 1952. In German.) Analysis and examples illustrating the use of Kirchhoff's theory for approximate calculation of diffraction effects, both for centimeter EM waves and for sound waves.

537.122 1297
Angular Momentum in Dirac's New Electrodynamics—R. W. Iskraut. (*Nature* (*London*), vol. 170, pp. 1125–1126; Dec. 27, 1952.)

537.122 1298
The Energy Momentum Tensor in Dirac's New Electromagnetic Theory—B. Hoffmann. (*Nature* (*London*), vol. 170, p. 1126; Dec. 27, 1952.)

537.291 1299
Diffraction by a Charged Filament—S. M. Rytov. (*Zh. Eksp. Teor. Fiz.*, vol. 22, pp. 510–511; April 1952.) The deflection of an electron by a charged infinite filament is considered and an equation is derived determining its trajectory.

537.311.1:538.632 1300
Interpretation of the Electron-Inertia Experiment for Metals with Positive Hall Coefficients—N. Rostoker. (*Phys. Rev.*, vol. 88, pp. 952–953; Nov. 15, 1952.) A critical discussion of the measurements described by Brown and Barnett (700 of March).

537.311.1:538.632 1301
Interpretation of EM Values for Electrons in Crystals—W. Shockley. (*Phys. Rev.*, vol. 88, p. 953; Nov. 15, 1952.) The EM values obtained by Brown and Barnett (700 of March) are shown to be in agreement with established theory if the mass of the holes is considered to be negative.

537.311.3 1302
Mobility in High Electric Fields—E. M. Conwell. (*Phys. Rev.*, vol. 88, pp. 1379–1380; Dec. 15, 1952.) Conductivity theory is extended to the case of strong ES fields, all electron collisions being assumed to be elastic. A relation is derived between mobility and relaxation time which is valid over a wide range of field strengths.

537.311.31.029.6 1303
The Anomalous Skin Effect—R. G. Chambers. (*Proc. Roy. Soc. A.*, vol. 215, pp. 481–497; Dec. 22, 1952.) Measurements were made on a number of metals at frequencies of 1.2 and 3.6 kmc, at temperatures in the range 2°–90°K. The variation of RF surface conductance with DC conductivity (σ) agrees well with the theoretical predictions of Reuter and Sondheimer (1354 of 1949), assuming that the electrons are scattered diffusely when they hit the surface of the metal. The results are used to estimate the effective value of σ/l (l = mean free path of electrons); the estimate for Cu agrees well with that based on theory, but those for Ag and Au are rather lower than the theoretical values. The results are largely dependent on the surface condition of the metal; the use of the two different frequencies enables the influence of this factor to be assessed.

537.311.33+537.226 1304
The Influence of the Surface States of Electrons on the Optical Properties of Semiconductors and Dielectrics—G. E. Pikus. (*Zh. Eksp. Teor. Fiz.*, vol. 22, pp. 331–338; March 1952.) The reflection of EM waves from a plane surface with electronic surface conduction is considered. For incidence angles close to 90°, reflection increases with the angle when the electric vector is parallel to the surface, but decreases when the electric vector is almost perpendicular to the surface.

537.311.33 1305
Experimental Verification of the Relationship between Diffusion Constant and Mobility of Electrons and Holes—(*Phys. Rev.*, vol. 88, pp. 1368–1369; Dec. 15, 1952.) Short pulses of electrons or holes were injected into single-crystal rods of p- and n-type Ge. As the pulse traveled along the rod under the influence of an electric field, diffusion took place, resulting in broadening of the pulse. A large number of measurements of pulse widths and transit times for two positions of the emitter point were made, and the most probable value of the ratio of diffusion constant to mobility was derived by the method of least squares. This was found to verify the relation $eD=\mu kT$ [see 3402 of 1952 (Landsberg)].

537.523.3+537.527.3 1306
Corona-Suppression Methods—A. H. Mankin. (*Elect. Mfg.*, vol. 47, pp. 125–127, 276; June 1951.) Physical aspects of corona discharge are discussed, and its prevention by pressurization or evacuation of electrical equipment, by increasing the radii of curvature of conductors, and by coating with or immersion in materials of high dielectric strength, is described.

537.523.74 1307
The Single-Electrode Discharge at Pressures from a Few Millimetres of Mercury to Atmospheric Pressure at the Frequency of 31.7 mc—G. S. Solntsev, M. Z. Khokhlov and E. A. Rodina. (*Zh. Eksp. Teor. Fiz.*, vol. 22, pp. 406–413; April 1952.) Experiments were conducted with discharges in air, N and Ar to investigate the characteristics of the "torch" discharge.

537.525.4 1308
Formative Time Lags of Uniform-Field Breakdown in N_2—G. A. Kachickas and L. H. Fisher. (*Phys. Rev.*, vol. 88, pp. 878–883; Nov. 15, 1952.)

537.562 1309
Dynamics of Plasma: Part 2—Plasma with Neutral Gas—A. Schlüter. (*Z. Naturf.*, vol. 6a, pp. 73–78; Feb. 1951.) Continuation of work noted in 2150 of 1951. To illustrate the theory, it is applied to investigate the influence of the self magnetic field on a glow discharge.

537.562:538.566 1310
Longitudinal Waves in an Ionized Medium (Plasma)—M. E. Gertsenshtein. (*Zh. Eksp. Teor. Fiz.*, vol. 22, pp. 303–309; March 1952.) The permittivity of an electronic plasma is calculated, taking account of electron motion; the value found depends on the spatial structure of the field. A concept of spatial dispersion is introduced. The properties of longitudinal waves and their relation to transverse waves are investigated.

538.22+548.0]:549.517.2 1311
Crystal Structure and Antiferromagnetism in Haematite—B. T. M. Willis and H. P. Rooksby. (*Proc. Phys. Soc.*, vol. 65, pp. 950–954; Dec. 1, 1952.)

538.221 1312
Ferromagnetism at Very High Frequencies: Part 4—Temperature Dependence of the Magnetic Spectrum of a Ferrite—G. T. Rado, R. W. Wright, W. H. Emerson and A. Terris. (*Phys. Rev.*, vol. 88, pp. 909–915; Nov. 15, 1952.) Continuation of work noted in 337 of 1951 (Rado *et al.*). Observations at 77°, 195° and 411°K are reported. By using single-domain particles embedded in wax, the rotational resonance was observed separately. The resonance frequencies decrease with increasing temperature; a theoretical interpretation is given. Auxiliary measurements of the spectroscopic splitting factor, saturation magnetization and coercive force are described.

538.3 1313
The Distribution of Currents in a Disk rotating in a Uniform Magnetic Field, and the Damping—L. N. Deryugin. (*Comp. Rend. Acad. Sci.* (*U.R.S.S.*), vol. 82, pp. 581–584. In Russian, 1952.)

538.56:535.312:519.3 1314
Application of the Calculus of Variations to the Determination of Reflection Coefficients—L. Ronchi and G. Toraldo di Francia. (*Rev. d'Optique*, vol. 31, pp. 481–484; Nov. 1952.) The method previously used to determine the reflection coefficient of a potential barrier [1894 of 1950 (Toraldo di Francia)] is here ap
plied to the vector field of EM waves to dete
mine the reflection coefficient of a stratifie
medium for TE and TM waves.

538.56:535.524 131
**The Complete System of Natural Electr
magnetic Oscillations of a Biaxial Anisotrop
Parallelepiped**—E. Hafner. (*Acta Phys. Au
triaca*, vol. 6, pp. 209–218; Nov. 1952.) Analys
of the EM field inside a rectangular cavit
resonator completely filled with an opticall
biaxial crystal.

538.566:537.53 131
Propagation in Electron-Ion Streams
R. Q. Twiss. (*Phys. Rev.*, vol. 88, pp. 1392
1407; Dec. 15, 1952.) Mathematical theory
developed for streams composed of N discret
beams. The solution of the propagation equa
tions is obtained in vector form by an extensio
of Hansen's theory (*Phys. Rev.*, vol. 47, p. 13
1935) and takes explicit account of initial an
boundary conditions. When certain restrictio
are placed on the transverse boundary cond
tions, the general solution satisfying arbitra
initial conditions can be expanded in terms of
complete orthogonal set of elementary vect
solutions. For this case the necessary and suff
cient conditions are found for amplificatio
and instability in the terminated and the u
terminated stream. The analysis is extended
a continuous velocity distribution. See also 65
of 1952.

538.569.4:621.315.212.1 131
**A Broad-Band Coaxial Stark Cell for Micr
wave Spectroscopy**—L. J. Rueger and R.
Nuckolls. (*Rev. Sci. Instrum.*, vol. 23, p. 63
Nov. 1952.) The cell consists of a coaxial stru
ture 10 ft long, the outer conductor being
$1\frac{1}{2}$-in. brass tube and the inner of $\frac{5}{8}$-in. bra
rod; the ends are vacuum sealed. Only a sing
wave transmission mode is possible in t
operation range 0.9–3.4 kmc/s. The applic
tion of a voltage between the conductors
some predetermined repetition rate modifi
the variation of the absorption with the fr
quency of the RF wave field, thus facilitati
detection of resonance. See also *Tech. New
Bull. nat. Bur. Stand.*, vol. 36, no. 10, pp. 150
151; Oct. 1952.

538.615:538.569.4.029.6 131
**Apparatus for Zeeman Effect Measure
ments on Microwave Spectra**—J. R. Eshba
and M. W. P. Strandberg. (*Rev. Sci. Instrum*
vol. 23, pp. 623–628; Nov. 1952.)

538.63 131
**The Connection between Transverse Ma
netogalvanic Effects and Resistivity**—A.
Perrier. (*Helv. Phys. Acta*, vol. 25, pp. 615
618; Nov. 1, 1952. In French.) The "magnet
galvanic rotation" due to the Hall effect in a
isotropic conductor is expressed in terms
transverse magnetogalvanic conductivity. I
variation with temperature and field intensi
is discussed briefly with reference to ferroma
netic and superconducting media.

GEOPHYSICAL AND EXTRATERRESTRIAL PHENOMENA

523.531:621.396.9 132
**A Radar Investigation of the Delta Aquar
Meteor Shower of 1950**—B. A. Lindbla
(*Chalmers tek. Högsk. Handl.*, no. 129, p
1–27; 1952.)

523.72:551.510.53 132
**Effects of Solar Radiation in the Upp
Atmosphere**—M. Nicolet. (*Ann. Géophys.*, v
8, pp. 141–193; April/June 1952.) A surve
paper. An account is given of the vario
radiations emitted by the sun and of t
ionization and dissociation effects resulti
from their absorption in the upper atmosphe

523.72:621.396.822:538.561:537.56 132
**Solar "Enhanced Radiation" and Plas
Oscillations**—H. K. Sen. (*Phys. Rev.*, vol. 8

pp. 816–822; Nov. 15, 1952.) The dispersion formula for plasma oscillations in a static magnetic field is derived by the Laplace-transform method used by Landau (1346 of 1948); the oscillations are unstable in frequency bands around multiples of the gyrofrequency. Numerical calculations for sunspot magnetic fields in the corona indicate that random fluctuations may be amplified, and afford support for the explanation given by Wild (2170 of 1951) of "enhanced radiation."

523.74:551.543:550.386 1323
Solar Activity and the Atmosphere—H. Koppe. (*Z. Met.*, vol. 6, pp. 369–378; Dec. 1952.) Statistical analysis of records confirms that correlation exists between geomagnetic disturbances and fluctuations of atmospheric pressure over Scandinavia. The hypothesis of planetary influence on solar activity is discussed. Assumptions regarding the mechanism of the sun's influence on the atmosphere are justified by measurements.

523.746:[523.77+53 1324
The Physical Conditions in Large Sunspots, deduced from Their Spectra—R. Michard. (*Comp. Rend. Acad. Sci.* (*Paris*), vol. 235, pp. 1608–1610; Dec. 22, 1952.) The temperature, electronic pressure and gas pressure at the center of a large sunspot are determined from published spectral data.

523.746"1952.07/.09" 1325
Provisional Sunspot Numbers for July to September, 1952—M. Waldmeier. (*Jour. Geophys. Res.*, vol. 57, no. 4, p. 534; Dec. 1952.)

523.755:550.38 1326
The Corona and Geomagnetism—M. J. Smyth. (*Observatory*, vol. 72, pp. 236–239; Dec. 1952.) Discussion of available data for the present solar-activity minimum shows the existence of a tendency for the central meridian passages of moderately bright λ 5303 regions to be followed by reduced geomagnetic activity for about three days.

523.78:551.510.535 1327
Effects of the Solar Eclipse of February 25, 1952 on the Ionospheric F_2 Region over Equatorial Africa—S. Estrabaud. (*Comp. Rend. Acad. Sci.* (*Paris*), vol. 235, pp. 1521–1523; Dec. 10, 1952.) Detailed note of effects observed in ionosphere soundings at Bangui. These are interpreted satisfactorily in terms of the existence of two interspersed layers X and G comprising the F_2 region. The lower layer X disappears as ionization decreases during occultation; during the reionization process, which occurs more rapidly at the base of the layer than at the top, the lower regions of X merge with the F_1 layer. The comparative insensitiveness of the upper layer G can be explained on the basis of corpuscular radiation.

523.8:621.396.822 1328
On Some Possible Mechanisms of Radio Stars: Part 1—The Crab Nebula—F. D. Kahn. (*Mon. Not. R. Astr. Soc.*, vol. 112, pp. 514–517; 1952.) Neither the deflection of fast electrons nor transitions of thermally excited electrons can account for the observed intensity of radiation.

23.8:621.396.822 1329
The Determination of the Position of a Radio Star—F. G. Smith. (*Mon. Not. R. Astr. Soc.*, vol. 112, no. 5, pp. 497–513; 1952.) Discussion of the accuracy of different methods.

23.8:621.396.822.029.64 1330
The Measurement of the Angular Diameter f Radio Stars—F. G. Smith. (*Proc. Phys. Soc.*, ol. 65, pp. 971–980; Dec. 1, 1952.) The phase-switching interferometer method described by Ryle (2497 of 1952) is considered in detail, and measurements made by this method are reorted.

523.854:621.396.822 1331
Electromagnetic Radiation from Cosmic Protons and the R.F. Radiation from the Galaxy—A. A. Korchak and Ya. P. Terletski. (*Zh. Eksp. Teor. Fiz.*, vol. 22, pp. 507–509; April 1952.) Calculations indicate that galactic RF radiation may be originated by the proton component of cosmic rays when the latter pass through the galactic fields.

525.35 1332
A New Discussion of the Changes in the Earth's Rate of Rotation—D. Brouwer. (*Proc. Nat. Acad. Sci., Wash.*, vol. 38, pp. 1–12; Jan. 1952.) A detailed analysis of available information on changes in the rate of rotation of the earth since 1820.

538.12:525.35 1333
A Negative Experiment relating to Magnetism and the Earth's Rotation—P. M. S. Blackett. (*Phil. Trans.*, vol. 245, pp. 309–370; Dec. 16, 1952.) An experiment was made to determine whether a 10 cm × 10 cm gold cylinder rotating with the earth produced a weak magnetic field; no such field was observed. The magnetometer used is described in detail.

538.12:550.38 1334
The Electromagnetic Field of a Rotating Uniformly Magnetized Sphere—A. Baños, Jr., and R. K. Golden. (*Jour. Appl. Phys.*, vol. 23, pp. 1294–1299; Dec. 1952.)

550.38:523.746.5 1335
The Variation of the Geomagnetic-Activity Recurrence Interval with the Solar Cycle—E. J. Chernosky. (*Trans. Amer. Geophys. Union*, vol. 32, pp. 861–865; Dec. 1951.)

550.38"1952.07/.09" 1336
Cheltenham [Maryland] Three-Hour-Range Indices K for July to September, 1952—R. R. Bodle. (*Jour. Geophys. Res.*, vol. 57, p. 534; Dec. 1952.)

550.384 1337
Isolation of the Eleven-Yearly Variation of the Horizontal Component of the Earth's Magnetic Field by Linear Combinations of Ordinates—P. Bernard. (*Ann. Géophys.*, vol. 8, pp. 248–252; April/June 1952.) The eleven-yearly component is brought into evidence by using Labrouste's method of analysis. This component has in general a minimum value 1.1 years after the maximum of sunspot activity and a total amplitude of 20 gamma. Exceptional results observed for certain stations are discussed.

550.384:525.35 1338
On Variations of the Geomagnetic Field, Fluid Motions, and the Rate of the Earth's Rotation—E. H. Vestine. (*Proc. Nat. Acad. Sci., Wash.*, vol. 38, pp. 1030–1038; Dec. 1952.) Brouwer's results (1332 above) are compared with changes with time in the westward drift of fluid moving near the surface of the earth's central core, as inferred from the westward drift of the eccentric-dipole field of geomagnetism.

550.385"1952.03/.09" 1339
Principal Magnetic Storms [March–Sept. 1952]—(*Jour. Geophys. Res.*, vol. 57, pp. 535–536; Dec. 1952.)

550.386 1340
International Data on Magnetic Disturbances, Second Quarter, 1952—J. Bartels and J. Veldkamp. (*Jour. Geophys. Res.*, vol. 57, pp. 531–533; Dec. 1952.)

551.510.52:535.32:538.56.029.64 1341
Measurement of Tropospheric Index-of-Refraction Fluctuations and Profiles—C. M. Crain, A. P. Deam and J. R. Gerhardt. (PROC. I.R.E., vol. 41, pp. 284–290; Feb. 1953.) Results are presented of measurements made with a direct-reading microwave refractometer over the sea and coastal areas near Lakehurst, N. J., and over Southern Ohio, for heights up to 10,000 ft. The refractometer was essentially the same as that previously described by Crain (2565 of 1950).

551.510.53 1342
Some Reactions Occurring in the Earth's Upper Atmosphere—D. R. Bates. (*Ann. Géophys.*, vol. 8, pp. 194–204; April/June 1952.) The photochemical reactions determining the equilibrium between N_2, N, NO and NO_2 are examined. The origin of the N_2O in the atmosphere is discussed; a considerable yield is necessary to balance the loss due to photodissociation. This gas may be formed in the troposphere by collisions between O or O_3 and N_2.

551.510.53 1343
The Height of the Atmospheric Electric-Equilibrium Layer—H. Israel. (*Ann. Géophys.*, vol. 8, pp. 253–257; April/June 1952. In Germn.) Continuation of previous work by Israël and Kasemir (*Ann. Géophys.*, vol. 5, pp. 313–324; 1949.) The values of electron concentration corresponding to two limiting assumptions regarding dependence of recombination coefficient (α) on pressure are compared with values deduced from determinations of D-layer ionization; α is found to be proportional to the cube root of the pressure. The height of the equilibrium layer is about 65 km.

551.510.535 1344
Relations between Temperature and the Phenomena of Photochemical Dissociation or Ionization in the Upper Atmosphere, particularly in the E Layer—J. Gauzit. (*Ann. Géophys.*, vol. 8, pp. 226–231; April/June 1952.) A calculation of the initial kinetic energy of oxygen atoms produced by photodissociation of oxygen molecules gives a value corresponding to a temperature >3000°K at altitudes between 100 and 130 km.

551.510.535 1345
A New Early-Morning Ionospheric Phenomenon—B. N. Bhargava. (*Nature* (*London*), vol. 170, pp. 983–984; Dec. 6, 1952.) Kodaikanal *h'f* records indicate the cessation of ionospheric echoes some minutes to several hours before sunrise and their reappearance at about the time of ground sunrise on about 60% of days during the period March–July 1952. The virtual height of the reflecting layer on reappearance of the echoes was 300–500 km. On mornings when the echoes did not disappear the new reflecting layer appeared suddenly and its height decreased rapidly to that of the overnight layer, viz. 200–250 km.

551.510.535 1346
An Investigation of the Ionizing Effect in the E Layer near Sunrise—R. Lindquist. (*Jour. Geophys. Res.*, vol. 57, pp. 439–458; Dec. 1952.) Virtual-height/time records for 150-kc signals show a sudden decrease in virtual height around ground sunrise. Analysis for the period Jan. 1950–Dec. 1951 shows that the difference between time of occurrence of the sunrise drop and sunrise at the reflection level is constant and independent of season. Absorption is considered the most likely cause of this effect. Calculations of absorption coefficients for O, N_2 and O_2 give results of the right order of magnitude in the case of O_2 only. Ionization of O_2 could be caused by ultraviolet radiation of $\lambda > 910$ Å.

551.510.535 1347
The $F_{1.5}$ Layer at Dakar and the Motion of the Sun—F. Delobeau. (*Comp. Rend. Acad. Sci.* (*Paris*), vol. 235, pp. 1673–1675; Dec. 22, 1952.) The occurrence of a layer between the normal F_1 and F_2 layers has been reported previously [1148 of 1951 (Delobeau *et al.*)]. The results of observations for the period July 1949 to July 1952 are shown graphically and discussed. Curves for summer, winter, and the equinoxes, showing the number of occurrences

of the $F_{1.5}$ layer for each hour of the day, are of similar shape, with maxima shortly after 1200 local time, the curves dropping to zero at about 0800 and 1700. The seasonal curves show maxima about the summer solstice and minima at about the winter solstice. Similar effects (thick F layer) have been observed at Singapore [989 of 1952 (Osborne)].

551.510.535 1348

Solar Ionospheric Tides in the F_2 Region—A. A. Weiss. (*J. Atmos. Terr. Phys.*, vol. 3, pp. 30–40; Jan. 1953.) "The equation of continuity for electrons subject to the influence of a vertical drift harmonic in time has been integrated by numerical methods, taking the processes of ion-production and recombination into account for physical conditions representative of the F_2 region. . . . The results of the analysis are applied to a brief discussion of the nature of the information regarding the vertical electron drift which can be derived from measured ionospheric data."

551.510.535 1349

Some Practical Determinations of the Electron Content below the Level of Maximum Ionization in the F_2 Region of the Ionosphere—B. W. Osborne. (*Jour. Atmos. Terr. Phys.*, vol. 3, pp. 58–67; Jan. 1953.) Ratcliffe's method (1292 of 1952) was applied to results of observations at Slough and at Singapore during 1949, and to simultaneous $h'f$ observations at Penang and Singapore during one week of July 1949. Seasonal and diurnal variations of maximum electron density differ from those of the total number n of electrons in a vertical column of unit cross-section in the F_2 region up to the level of maximum ionization. The variations of n show a greater dependence on the solar zenith angle. Diurnal variations of the latitude gradient of n near the magnetic equator are briefly discussed. It appears probable that, as the latitude alters, the local noon value of n goes through a flat maximum in equatorial latitudes, whereas the noon value of maximum electron density goes through a sharp minimum near the magnetic equator and exhibits the well-known "equatorial trough."

551.510.535:523.746:621.396.11 1350

The Differences in the Relationship between Ionospheric Critical Frequencies and Sunspot Number for Different Sunspot Cycles—S. M. Ostrow and M. PoKempner. (*Jour. Geophys. Res.*, vol. 57, pp. 473–480; Dec. 1952.) Statistical analysis of data from Washington, D. C., and Watheroo, Australia, show significant differences for months near the equinoxes, and also seasonal variations between the 1935–1944 and 1944–1952 cycles. Inconclusive results for other months are ascribed in part to the small sample size of available data. For radio propagation predictions therefore only current cycle data should be used.

551.510.535:538.566.3 1351

Calculation of Absorption in the Ionospheric Propagation of Short Waves—A. Bolle and P. Dominici. (*Ann. Geofis.*, vol. 5, pp. 377–396; July 1952.) Formulae and graphs necessary for calculation of the absorption in the absence of and in the presence of the geomagnetic field are assembled and explained.

551.510.535:551.594.13 1352

Conductivity of the Ionosphere—W. G. Baker and D. F. Martyn. (*Nature* (*London*), vol. 170, pp. 1090–1092; Dec. 27, 1952.) The investigations of various workers relative to Balfour Stewart's dynamo theory of geomagnetic diurnal variations are reviewed, and the fundamental principles involved in the production of electric currents in the ionosphere by tidal winds are re-examined. Three conductivities, two of which are related to the Hall effect, appear to be involved. One of these has two relatively small maxima at 140 km height (due mainly to ions) and 75 km (due to electrons). The second has a broad maximum at 105±35 km, thus including all the E-region ionization, and the third has a very pronounced sharp maximum at 100±10 km. Discussion shows that the effective conductivity of the ionosphere, over most of the earth, is some twelve times greater than that deduced when the Hall current is ignored, and near the magnetic equator the conductivity is increased further by a factor of 2.4. Equations developed appear to account quantitatively for the high conductivity required by the dynamo theory, and also for the increased conductivity near the magnetic equator. Near the equator the current system should be in a relatively thin layer centered at about 100 km height. Evidence of the existence of a current sheet between the 93-km and 105-km levels has recently been obtained by Singer *et al.* (1353 below) in rocket experiments.

551.510.535:551.594.13 1353

Dynamo Currents and Conductivities in the Earth's Upper Atmosphere—S. F. Singer, E. Maple and W. A. Bowen, Jr. (*Nature* (*London*), vol. 170, pp. 1093–1094; Dec. 27, 1952.) Discussion of the results of rocket measurements reported previously (2713 of 1951). The observed current system would account for the exceptionally large geomagnetic diurnal variations found at Huancayo, and strongly supports Balfour Stewart's dynamo theory of the diurnal variations. By taking account of polarization due to the Hall effect, the large discrepancy between conventionally calculated ionosphere conductivities and the value of the conductivity required by the dynamo theory (using accepted values for the velocity of high-altitude winds) can be eliminated. Further rocket measurements, on both magnetically quiet and disturbed days, are very desirable.

551.594 1354

Studies of the Atmospheric Potential Gradient: No. 5—Current Theory of the Electric Field in the Air: Part 2—H. W. Kasemir. (*Arch. Met. A*, *Wien*, vol. 5, pp. 56–70; April 28, 1952.) Particular cases arising from the theory given previously (407 of 1952) are examined in detail, using moderately advanced mathematics.

551.594 1355

Studies of the Atmospheric Potential Gradient: No. 6—Examples of Atmospheric Electrical Phenomena in Foggy Conditions—H. Israël and H. W. Kasemir. (*Arch. Met. A*, *Wien*, vol. 5, pp. 71–85; April 28, 1952.) From an examination of numerous records of the atmospheric electric field and the vertical current obtained at stations in lowland and mountainous regions during fog, several types of characteristic reaction are distinguished; these are discussed in detail.

551.594.5 1356

Theories of the Aurora Polaris—S. Chapman. (*Ann. Géophys.*, vol. 8, pp. 205–225; April/June 1952.) The discussion presented deals only with theories based on the action of streams or clouds of neutral ionized gas ejected from the sun.

551.594.5 1357

The Geometry of Radio Echoes from Aurorae—S. Chapman. (*Jour. Atmos. Terr. Phys.*, vol. 3, pp. 1–29; Jan. 1953.)

551.594.5:537.533/.534]:538.6 1358

The Streaming of Charged Particles through a Magnetic Field as a Theory of the Aurora—B. C. Landseer-Jones. (*Jour. Atmos. Terr. Phys.*, vol. 3, pp. 41–57; Jan. 1953.)

52+55](083.6) 1359

Landolt-Börnstein Zahlenwerte und Funktionen aus Physik, Chemie, Astronomie, Geophysik und Technik: Vol. 3—Astronomie und Geophysik. [Book Review]—J. Bartels and P. ten Bruggencate (Volume Eds.). Publishers: Springer-Verlag, Berlin-Göttingen-Heidelberg, 1952, 795 pp., £21. 14s. (*Jour. Atmos. Terr. Phys.*, vol. 3, pp. 70–71; Jan. 1953.) "should be available in any library catering for meteorologists, geophysicists or astronomers. . . . No book written in English contains such a useful and complete collection of information."

LOCATION AND AIDS TO NAVIGATION

621.396.9 1360

First Demonstration of Port Radar Equipment in Germany—(*Funk-Technik*, *Berlin*, vol. 7, pp. 574–575; Nov. 1952.) Note on demonstrations at Hamburg and Bremen of two types of Decca radar equipment: (*a*) simple equipment for small and medium-size ports; (*b*) more elaborate equipment for large ports. A 12-in. viewing screen is used. The frequency is 9.4 kmc.

621.396.9:551.5:061.3 1361

Application of Radar to Meteorology—R. F. Jones. (*Nature* (*London*), vol. 170, pp. 1004–1005; Dec. 13, 1952.) Summarized report of the proceedings at the third Radar Weather Conference, McGill University, Montreal, September 1952.

621.396.9:551.578 1362

The Scattering of Radio Waves by Meteorological Particles—N. R. Labrum. (*Jour. Appl. Phys.*, vol. 23, pp. 1324–1330; Dec. 1952). Calculations are made of the intensity of the signal scattered back by clouds of ice particles or water drops or mixtures of the two. In the case of ice the echo intensity is almost independent of particle shape; in the case of water the intensity increases rapidly as the shape of the drops departs from sphericity. The results are used to explain the "bright-band" phenomenon. When the scattering particles are not spherical, the polarization of the radiation may undergo alteration.

621.396.9:551.578 1363

Some Experiments on Centimeter-Wavelength Scattering by Small Obstacles—N. R. Labrum. (*Jour. Appl. Phys.*, vol. 23, pp. 1320–1323; Dec. 1952.) Measurements were made of the power scattered back from small steel spheres, hemispherical water drops and melting ice particles; waveguide technique was used, the frequency being 3 kmc. The observations support the theoretical results reported in 1362 above. The intensity of the echo passes through a maximum at some stage during the transition from ice particles to water drops.

621.396.9:551.578.1/.4 1364

Cross-Polarization of the Radar Melting-Band—I. C. Browne and N. P. Robinson. (*Nature* (*London*), vol. 170. pp. 1078–1079; Dec. 20, 1952.) Recent observations at Cambridge on 3.2-cm wavelength and at Malvern on 8-mm wavelength are reported which show that the melting particles found just below the freezing level, which give rise to the radar melting band [2222 of 1950 (Hooper & Kippax)], produce back-scattered radiation with a greater cross-polarized component than that given by the rain below and the snow above the freezing level. Separate aerials were used for transmission and reception, the echo intensities being compared for the cases in which the two aerials had (*a*) parallel, (*b*) perpendicular planes of polarization. A possible explanation of the effect is suggested.

621.396.9.001.4 1365

Measurements relating to [moving-target] Radar Equipment with Fixed-Target-Echo Elimination.—Cauchois. (See 1446.)

621.396.9.001.57 1366

The Use of Dielectric Lenses in Reflection Measurements—J. R. Mentzer. (Proc. I.R.E., vol. 41, pp. 252–256; Feb. 1953.) In order to minimize the effects of Fresnel diffraction, due to short range, in the measurement of radar echoing areas by means of models, a styrofoam lens with a refractive index of 1.015 and dielecric constant of 1.03 was used in front of the arget. The measured broadside radar echoing rea of a cylinder, of length about 80% of the ens diameter, was doubled by use of the lens.

621.396.932 1367

Quantitative Investigation of the Increased Accuracy of Direction Finding using the C.R. Direction Finder—H. Gabler, G. Gresky and M. Wächtler. (*Arch. Elekt. Übertragung*, vol. 6, pp. 507–513; Dec. 1952.) Report of a compari- on of goniometer and CRO equipment, carried out on board the research ship *Gauss* during August 1952. Measurements are tabulated and discussed. The CRO equipment is preferred on account of its objective indication and greater accuracy (viz., to within ±1°) especially at low field strengths and in the presence of interference.

621.396.933 1368

Synthetic Radar Trainer—(*Wireless World*, vol. 59, pp. 123–124; March 1953.) A note on electromechanical equipment for simulating the flight paths of aircraft to provide trainee control officers with experience in the interpretation of radar displays.

621.396.933.23 1369

Instrument-Approach-System Steering Computer—W. G. Anderson and E. H. Fritze. (Proc. I.R.E., vol. 41, pp. 219–228; Feb. 1953.) The analysis presented is mainly concerned with the problem of lateral guidance in the I.L.A.S. (Instrument Landing Approach System), the ground equipment for which has been nstalled at airports throughout the U.S.A. The steering computer described uses data regard- ng aircraft bank angle, heading, and localizer deviation to determine a correct steering indication for the pilot to follow.

MATERIALS AND SUBSIDIARY TECHNIQUES

535.37 1370

Radio-frequency Field Quenching of Ultraviolet Excited Phosphors—T. Miller. (*Jour. Appl. Phys.*, vol. 23, pp. 1289–1293; Dec. 1952.) Experiments were made with various phosphors to determine the dependence of the quenching action of an applied RF field on the strength and frequency of the field. Results are shown in graphs. Sulphide phosphors were found to exhibit the quenching action, while zinc phosphate and zinc orthosilicate did not. Fatigue effects were also investigated.

535.37:537.311.33:546.482.21 1371

Variation of the Luminescence and Electrical Conductivity of CdS Crystals on Irradiation with α Particles—I. Broser and R. Warminsky. *Z. Naturf.*, vol. 6a, pp. 85–102; Feb. 1951.)

537.226+621.315.611 1372

Dielectric Materials—G. I. Skanavi. (*Pri- oda*, pp. 23–32; June 1952.) The theory of dielectrics is discussed, with particular atten- ion to ceramic materials, including ferroelec- rics. The mechanism of electrical conduction n dielectrics is considered in detail and differ- nt types of breakdown (thermal, electrical and hemical) are discussed.

37.226 1373

Ferroelectric Materials—S. B. Gurevich nd V. G. Panchenko. (*Priroda*, pp. 54–61; March 1952.) A general review of the subject. Theoretical interpretations of ferroelectric roperties, mainly by Russian physicists, are iscussed, and possible practical applications of hese materials are indicated.

37.226 1374

Ferroelectricity in Oxides of Fluorite Struc- ure—W. R. Cook, Jr., and H. Jaffe. (*Phys. Rev.*, vol. 88, p. 1426; Dec. 15, 1952.) Ferro- lectricity in a simple crystal structure has been ound in two compounds. $Cd_2Nb_2O_7$ is of face- enterd cubic structure with permittivity rising o a peak as the temperature falls to −103°C, the Curie point, below which it is ferroelectric. The analogous compound $Pb_2Nb_2O_7$, with rhombohedral symmetry, has a permittivity which also rises with falling temperature.

537.226.1 1375

The Relation between Breakdown Strength and Mobility of Charges in a Dielectric—E. K. Zavadovskaya. (*Comp. Rend. Acad. Sci.* (*U.R.S.S.*) vol. 82, pp. 565–566; Feb. 1, 1952. In Russian.)

537.228.1:621.396.611.21 1376

Piezoelectric Resonators and Oscillators using Quartz and Synthetic Crystals—R. Bechmann. (*Telefunken Ztg.*, vol. 25, pp. 229–245; Nov. 1952.) Properties of different classes of piezoelectric materials are discussed. Elastic and piezoelectric moduli and the modes of vibration for the 32 crystal symmetry classes are listed. Another table gives numerical factors for calculating the mechanical displacement and oscillation constants according to the vibration mode and taking account of the effects of partial electrodes and air gaps on the resonance frequency. Methods of obtaining zero temperature coefficient of frequency are discussed, in particular that in which "rotated" plates vibrate in a thickness or contour shear mode. Frequency and capacitance constants determined experimentally for such crystals of quartz, EDT and DKT (potassium tartrate hemihydrate) are given.

537.311.31 1377

Resistance of Metals at High Current Density in Pulse Conditions—L. A. Ignat'eva and S. T. Kalashnikov. (*Zh. Eksp. Teor. Fiz.*, vol. 22, pp. 385–399; April 1952.) The electrical resistance of thin wires was investigated for current pulses lasting several tens of microseconds, with current densities up to 5×10^6A/cm^2. For Au, Ag and Cu the resistance values are the same as with weak currents, while for Pt and W the resistance values are several times greater for current densities above 10^6A/cm^2.

537.311.32:549.514.51 1378

Dependence of the Electrical Conductivity of Quartz on the Electrical Field, the Temperature and the Magnetic Field—P. E. Sarzhevski. (*Comp. Rend. Acad. Sci.* (*U.R.S.S.*), vol. 82, pp. 571–574; Feb. 1, 1952. In Russian.)

537.311.33 1379

The Measurement of Drift Mobility in Semiconductors—R. Lawrance and A. F. Gibson. (*Proc. Phys. Soc.*, vol. 65, pp. 994–995; Dec. 1, 1952.) The methods described by Haynes and Shockley (2109 of 1949 and 1928 of 1951) and Shockley et al. (380 of 1950) are modified by using a continuous emitter current in conjunction with the pulsed sweep field.

537.311.33 1380

Thermo- and Galvano-magnetic Coefficients for Semiconductors—E. H. Putley. (*Proc. Phys. Soc.*, vol. 65, pp. 991–993; Dec. 1, 1952.) Formulas derived for these coefficients by Sommerfeld and Frank in 1931, using classical statistics methods, give incorrect results because they are based on the assumption that the only significant contribution to the thermal conductivity is the electronic one, whereas in semiconductors the lattice contribution is normally many times larger than the electronic. Bronstein in 1932 took this into account. Comparison of the two sets of formulas shows agreement for Hall and Nernst coefficients and divergence for Ettingshausen and Righi-Leduc coefficients; an explanation of these facts is presented.

537.311.33 1381

Determination of the Effective Mass of Current Carriers in Semiconductors from their Infrared Absorption—K. B. Tolpygv. (*Zh. Eksp. Teor. Fiz.*, vol. 22, pp. 378–380; March 1952.) Formulas are derived showing the relation between the optical properties of a semiconductor, the effective mass M and the mean free path of a current carrier. Using these formulas M can be determined experimentally.

537.311.33 1382

Energy States of Overlapping Impurity Carriers in Semiconductors—C. Erginsoy. (*Phys. Rev.*, vol. 88, pp. 893–894; Nov. 15, 1952.) An analytical solution is given of the Schrödinger equation for the spherically symmetrical wave function of an impurity carrier in a zero-wave-number state, on the basis of the Wigner-Seitz approximation. This solution reveals certain unforeseen characteristics of the overlapping mechanism.

537.311.33:546.561-31 1383

The Semiconductor Properties of Cu_2O: Part 1—Production Methods for Operational Stability—G. Blankenburg and K. Kassel. (*Ann. Phys., Lpz.*, vol. 10, pp. 201–210; April 15, 1952.) Critical consideration of the process involved in producing Cu_2O by oxidation of Cu showed that an annealing process at 1075°C for 150 hours was necessary if the resultant product was to contain no trace of Cu or CuO.

537.311.33:546.561-31 1384

The Semiconductor Properties of Cu_2O: Part 2—Influence of Lattice Defects on the Optical Absorption—K. Kassel. (*Ann. Phys., Lpz.*, vol. 10, pp. 211–216; April, 15 1952.)

537.311.33:546.561-31 1385

The Semiconductor Properties of Cu_2O: Part 3—Dependence of the Electrical Conductivity at Low Temperature on the Oxygen Pressure during a Previous Annealing Process—G. Blankenburg, C. Fritzsche and G. Schubart. (*Ann. Phys., Lpz.*, vol. 10, pp. 217–231; April 15, 1952.)

537.311.33:546.561-31 1386

The Semiconductor Properties of Cu_2O: Part 4—Conductivity Measurements at High Temperatures—O. Böttger. (*Ann. Phys., Lpz.*, vol. 10, pp. 232–240; April 15, 1952.) Results at temperatures between 600°C and 1000°C show that the conductivity is proportional to $p^{1/7}$ (where p is the oxygen pressure during annealing) only for pressures $>10^{-2}$mm Hg.

537.311.33:546.561-31 1387

The Semiconductor Properties of Cu_2O: Part 5—Interpretation of the Dependence of Electrical Conductivity at Low Temperatures on the [oxygen] Pressure during Annealing—G. Blankenburg and O. Böttger. (*Ann. Phys., Lpz.*, vol. 10, pp. 241–252; April 15, 1952.)

537.311.33:[546.817.221+546.817.231+546.817.241 1388

Intrinsic Conduction in PbS, PbSe, PbTe—E. H. Putley. (*Proc. Phys. Soc.*, vol. 65, p. 993; Dec. 1, 1952.) Measurements further to those previously noted (3140 of 1952) give supplementary information about the gap between the full and conduction bands for PbSe.

537.311.33:621.314.634 1389

Temperature Variation of the Rectification Characteristics at Selenium Contacts—E. W. Saker. (*Proc. Phys. Soc.*, vol. 65, pp. 990–991; Dec. 1, 1952.) Report of measurements made at temperatures of +60°, +20° and −42°C to determine the diffusion potential.

537.533:539.379 1390

Electron Emission from Cold-Worked Metals—W. Pepperhoff. (*Z. Metallkde*, vol. 43, pp. 402–403; Nov. 1952.) Mechanical working of metals gives rise to an electron emission which can be demonstrated by its blackening effect on a photographic emulsion. Energy considerations indicate that the emission is a result of the adsorption of oxygen.

537.533:[546.482.21+546.482.31 1391

Field Emission from Photoconductors—L. Apker and E. Taft. (*Phys. Rev.*, vol. 88, pp.

1037–1038; Dec. 1, 1952.) Field emission from single-crystal needles of CdS and CdSe was found to increase greatly when the emitting areas were illuminated by light of wavelength exciting photoconduction. Possible mechanisms are discussed.

537.582 1392
Thermionic Constants of Metals and Semiconductors: Part 2—Metals of the First Transition Group—S. C. Jain and K. S. Krishnan. (*Proc. Roy. Soc. A*, vol. 215, pp. 431–437; Dec. 22, 1952.) The method of determination described in part 1 (3467 of 1952) can be used for most metals by coating the inner walls of the graphite chamber with a thick layer of the metal. Measurements are reported on metals of the series from Ti to Ni.

538.221 1393
Effective Magnetic Distances in Metals, Alloys and Ferromagnetic and Antiferromagnetic Combinations of the Iron Group—R. Forrer. (*Ann. Phys.* (*Paris*), vol. 7, pp. 605–621, Sept./Oct. 1952.) Experimental results are reported and shown graphically. The limits of the interaction distances considered responsible for ferromagnetism are relatively well defined except for the upper limit for Mn and Cr and the lower limit for Ni. The lower limit of the ferromagnetic zone rises steadily from Ni to Cr.

538.221 1394
The Thermal and Thermoelectrical Properties of Ferromagnetic Metals—A. I. Rezanov. (*Comp. Rend. Acad. Sci.* (*U.R.S.S.*) vol. 82, pp. 885–887; Feb. 21, 1952, In Russian.) A theoretical discussion relating the properties of the metals to the electronic processes in the crystal lattice.

538.221 1395
Ferroxcube—(*Philips tech. Commun.* (*Australia*), no. 4, pp. 3–13; 1952.) Properties and various data on available types and grades of ferroxcube are tabulated and shown graphically.

538.221 1396
A Survey of the Possible Applications of Ferrites—K. E. Latimer and H. B. MacDonald. (*Philips Tech. Comm.* (*Australia*), no. 4, pp. 13–27; 1952.) A general review, including curves and tables illustrating the practical design of HF transformer and filter-coil cores.

538.221 1397
Spontaneous Magnetization of Ferrites—R. Pauthenet. (*Ann. Phys.* (*Paris*), vol. 7, pp. 710–747; Sept./Oct. 1952.) The experimental apparatus is described in detail. The theory of ferrimagnetism accounts satisfactorily for the variations with temperature of the spontaneous magnetization of Ni, Co and Fe ferrites and also for the variations of absolute saturization magnetization of NiZn ferrites with low Zn content. The effects of quenching are interpreted on the basis of Néel's theory (3159 of 1949).

538.221:538.632 1398
The Hall Effect in Nickel Ferrite—S. Foner. (*Phys. Rev.*, vol. 88, pp. 955–956; Nov. 15, 1952.) Experiments are described which indicate that the Hall effect for a Ni ferrite resembles that for ferromagnetic metals, and is composed of an ordinary effect proportional to the field together with an extraordinary effect proportional to the magnetization.

538.221:538.652 1399
Magnetostriction of Single Crystals of Cobalt and Nickel Ferrites—R. M. Bozorth and J. G. Walker. (*Phys. Rev.*, vol. 88, p. 1209; Dec. 1, 1952.) Measurements were made on a crystal of Co ferrite cut parallel to the (001) plane and subjected to field strengths up to 5000 oersted. An unusually large magnetostriction $\Delta l/l=-540\times10^{-6}$ in the [100] direction was observed. On cooling the crystal in a magnetic field the value found was -720×10^{-6} The results are shown in graphs, together with corresponsing results for crystals of Ni ferrite.

538.221:621.3.017.31 1400
Eddy-Current Losses in Ferromagnetic Materials with Complex Conductivity—H. Henniger. (*Deutsche Elektrotech.*, vol. 6, pp. 399–402 and 528–531; Sept./Oct. 1952.) A formula is derived for the eddy-current loss in a coil former of rectangular section and the *Q*-factor of the coil is deduced. The advantages of ferrites for HF applications are noted.

538.221:[621.317.335.2+621.317.411 1401
Dielectric Constant and Permeability of Various Ferrites in the Microwave Region—T. Okamura, T. Fujimura and M. Date. (*Phys. Rev.*, vol. 88, p. 1435; Dec. 15, 1952.) Corrections to paper noted in 2535 of 1952.

538.639 1402
Additional Resistance of Ferromagnetic Metals—A. G. Samoilovich and V. A. Yakovlev. (*Zh. Eksp. Teor. Fiz.*, vol. 22, pp. 350–355; March 1952.) The effect of spontaneous magnetization of a ferromagnetic crystal on its electrical resistance is considered. The temperature dependence of the additional resistance is established for low temperatures.

546.28+546.289 1403
Plastic Deformation of Germanium and Silicon—C. J. Gallagher. (*Phys. Rev.*, vol. 88, pp. 721–722; Nov. 15, 1952.) Observations on Ge single crystals are reported. The material becomes ductile at temperatures >500(C; at temperatures >500°C; at temperatures <600°C there is a time delay in the deformation. Si single crystals become ductile at temperatures >900°C.

546.28+546.289 1404
The Plasticity of Silicon and Germanium—F. Seitz. (*Phys. Rev.*, vol. 88, pp. 722–724; Nov. 15, 1952.) Discussion of measurement results obtained by Gallagher (see 1403 above). A possible explanation of the temperature-dependent time delay of the deformation is advanced.

546.289 1405
Germanium, Produced as a Byproduct, has become of Primary Importance—A. P. Thompson and J. R. Musgrave. (*Jour. Metals*, vol. 4, pp. 1132–1137; Nov. 1952.) Description of production methods used in the U.S.A. and in England, with a brief review of the properties and applications of Ge.

546.289:537.311.33 1406
Grain Boundary Barriers in Germanium—W. E. Taylor, N. H. Odell and H. Y. Fan. (*Phys. Rev.*, vol. 88, pp. 867–875; Nov. 15, 1952.) High nonlinear resistance at grain boundaries of *n*-type Ge has been reported previously [e.g. 1939 of 1950 (Odell & Fan)] and is attributed to surface states as postulated by Bardeen (3086 of 1947). The barriers are able to withstand voltages as high as 100 V because the surface charge increases with increasing applied voltage. Both d.c. and a.c. measurements are reported. At sufficiently low temperatures the barrier capacitance is frequency independent, indicating that the current is mainly electronic, while at higher temperatures the capacitance is markedly frequency dependent, indicating the increasing importance of hole current. The height of the potential barrier above the Fermi level is independent of temperature. A small difference between the measured breakdown voltages for the two directions is attributed to a difference between the impurity concentrations on the two sides of the boundary.

546.289:537.311.33 1407
Acceptors Produced in Germanium by Quenching from High Temperatures—C. Goldberg. (*Phys. Rev.*, vol. 88, pp. 920–924; Nov. 15, 1952.) Acceptors were produced in Ge single crystals of both *n* and *p* type by very rapid cooling from high temperatures. On the basis of previous experiments by Fuller et al (2235 of 1952) it is assumed that the acceptor levels are due to Schottky defects. A formula is derived for the equilibrium concentration of ionized Schottky defects; from consideration of this together with the experimental results it is estimated that 1.49 ±0.12 eV must be supplied to the crystal to form a Schottky defect. The activation energy of self-diffusion produced by a vacancy mechanism is 2.0 ±0.1 eV.

546.289:548.55:537.311.33 1408
Preparation of Germanium Single Crystals—L. Roth and W. E. Taylor. (Proc. I.R.E., vol. 41, p. 218; Feb. 1953.) Corrections to paper abstracted in 744 of March.

546.817.241:537.311.33 1409
Transistor Action in Lead Telluride—C. A. Hogarth. (*Proc. Phys. Soc.*, vol. 65, pp. 958–963; Dec. 1, 1952.) Transistor action has been observed in artificial *p*-type single crystals of PbTe examined at 90°K. The experimental method is described; values of current gain >1 are reported. Since good rectification and transistor action are observed only at low temperatures, it is not expected that a useful device will be developed from this material.

546.817.824–31:537.226 1410
Dielectric Properties of Monocrystals of Lead Titanate—I. N. Belyaev and A. L. Khodakov. (*Zh. Eksp. Teor. Fiz.*, vol. 22, pp. 376–378; March 1952.) Previous investigations were carried out on polycrystalline samples of $PbTiO_2$, but since these are difficult to obtain in a pure form, experiments were repeated with monocrystals. The results confirm that $PbTiO_3$ has ferroelectric properties.

549.212:53 1411
Properties of Graphite—J. P. Howe. (*Jour. Amer. Ceram. Soc.* vol. 35, pp. 282–375; Nov. 1, 1952.) Review of present knowledge of the crystal structure and the thermal, electrical, and mechanical properties of graphite. 31 references.

621.775.7 1412
Austria is Host to World Congress on Powder Metallurgy—H. H. Hausner. (*Metal Progr.*, vol. 62, pp. 79–83; Nov. 1952.) Report of the proceedings at a conference held at Reutte, Austria, in June 1952.

MATHEMATICS

517.941.91:518.61 1413
Numerical and Graphical Integration of Oscillation Equations—S. Flügge. (*Z. Phys.*, vol. 133, pp. 449–450; Nov. 4, 1952.) The application of recurrence formulas has advantages over the Taylor-series method of integrating equations of the type $d^2y/dx^2+f^2(\lambda)y=0$, where f is the oscillation frequency. A simple graphical integration method is briefly described.

681.142 1414
Design Features of the ERA 1101 Computer—F. C. Mullaney. (*Elect. Eng., N. Y.*, vol. 71, pp. 1015–1018; Nov. 1952.) Description of a single-address binary-system parallel computer with magnetic storage, in operation since 1951.

681.142 1415
Programming a Digital Computer to Learn—A. G. Oettinger. (*Phil. Mag.*, vol. 43, pp. 1243–1263; Dec. 1952.) By "the application of the techniques described, digital computers can be made to serve as models in the study of the functions and of the structures of animal nervous systems."

681.142:517.9 1416
The Use of Extrapolation Techniques with Electrical Network Analogue Solutions—R. Culver. (*Brit. Jour. Appl. Phys.*, vol. 3, pp. 376–378; Dec. 1952.) An outline is given of

umerical techniques which can be used, in
olving certain differential equations, to esti-
ate the exact result from finite-difference so-
tions obtained with various mesh sizes.

31.142:621.3.015.7 1417
**Electronic Multiplier using Pulses Modu-
ted in Duration and Amplitude**—E. Flater
nd K. Fränz. (*Rev. Telegr. Electronica, Buenos
ires*, vol. 41, pp. 570–573; Sept. 1952.) A 15-
ube analogue computer capable of effecting
000 multiplications/sec, accurate to within
%, is based on the generation of pulses whose
uration and amplitude are respectively pro-
ortional to the quantities to be multiplied.

31.142:621.383 1418
Intermittent-Feed Computer-Tape Reader
-B. G. Welby. (*Electronics*, vol. 26, pp. 115–
17; Feb. 1953.) Description of a six-photocell
ystem used for reading the teleprinter-tape
nput to the Ferranti digital computer Mark I.
ive of the cells read the five-hole tape charac-
ers, while the sixth is associated with the
procket holes and provides a signal for con-
rolling the tape movement. Speeds up to 200
haracters/sec are attainable. See also 454 of
ebruary (Packer and Wray).

01.8 1419
**The Design and Analysis of Experiments
Book Review]**—O. Kempthorne. Publishers:
hapman and Hall, London; J. Wiley & Sons,
ew York, 631 pp.; 1952. 68s. (*Nature* (*Lon-
on*), vol. 170, p. 991; Dec. 13, 1952.) Presents
the general statistical theory on which all
es of experimental designs rest, together with
structions for constructing, analyzing and in-
rpreting some of the more complex designs."

MEASUREMENTS AND TEST GEAR

31.76:621.3.015.7 1420
**Precise Determination of a Time Interval
y means of an Electronic Device. Automatic
eturn to Zero. Choice of Reference Frequency**
-A. Peuteman. (*Comp. Rend. Acad. Sci.
Paris*), vol. 235, pp. 1381–1382; Dec. 1, 1952.)
he arrangement described comprises a stable
cillator connected to a counter circuit which
perates a flip-flop to produce pulses marking
e beginning and end of the time interval. The
cillator frequency is chosen so as to minimize
e effects of timing uncertainties inherent in
e operation of the circuits.

31.764:621.398 1421
Time by Telearchics—(*Wireless World*, vol.
, p. 136; March 1953.) Brief note on an ex-
rimental arrangement for controlling a con-
entional pendulum clock from pulses radiated
1-sec intervals by a standard-frequency
rvice, using an electromagnetically operated
wl.

1.3.018.41(083.74)+529.786]:538.569.4
1422
Atomic Clocks and Frequency Stabilization
C. R. S. Ince. (*Jour. Appl. Phys.*, vol. 23, pp.
08–1409; Dec. 1952.) Comment on 1659 of
52 (Townes).

1.3.018.41(083.74):621.396 1423
[British] Standard Frequencies—(*Wireless
orld*, vol. 59, p. 119; March 1953.) Announce-
ent of a revision of the schedule of transmis-
ons from Rugby to give a 24-hour service
ing several of the frequencies 2.5, 5, 10, 15,
and 25 mc.

1.311.62(083.74):621.316.722.1 1424
**A Stabilized and Calibrated A.C. Voltage
urce**—C. T. J. Alkemade and G. van den
ink. (*Appl. Sci. Res.*, vol. B3, pp. 47–50;
52.) Equipment is described that provides a
usoidal stabilized a.c. voltage of frequency
cps for use as a reference standard in bal-
ce measurements of photoelectric currents
tained with the exciting light beam chopped
the same frequency. The measurements are
de by means of an AC amplifier and AC galvanometer, as described by Milatz and Bloembergen (1908 of 1949).

621.317+621.398]:621.39.001.11 1425

Modern Signal and Information Theories. Applications to Telecontrol and Measurements—J. Loeb. (*Rev. Gén Élect.*, vol. 61, pp. 499–516; Nov. 1952.) See also 2535 and 3041 of 1951.

621.317.331(083.74) 1426

Modified Bridge Method for Absolute Determination of Ohm—M. Romanowski. (*Canad. Jour. Phys.*, vol. 30, pp. 631–636; Nov. 1952.) Campbell's original bridge and Picard's modification are examined; by re-arranging the components, two other networks for the same measurement can be obtained. A model of one of these was built using manganin circuit elements to reduce temperature effects. No determination of self-inductance is necessary. This bridge requires a mutual inductance equal to twice the value of the standard.

621.317.35 1427

The Analysis of Waves containing Harmonics up to the Twelfth—D. R. Turner. (*Electronic Eng.*, vol. 25, pp. 30–35; Jan. 1953.) Description of a method similar to that of Kemp (1374 of 1952) but applicable to waves containing both even and odd harmonics.

621.317.361 1428

Instantaneous Measurement of a Varying Frequency—L. U. Hibbard and D. E. Caro. (*Jour. Sci. Instr.*, Nov. 1952, vol. 29, pp. 366–370.) The passage of a rapidly varying frequency through a particular value can be observed by beating the varying frequency with a fixed-frequency reference signal. The output of the mixer valve is peak rectified and displayed on a CRO. The method is particularly suitable for frequency/time functions which are linear or have an inflection at the point of observation. Errors due to nonlinear functions are examined. In the case of repetitive functions, the phasing of the fixed oscillator with respect to the varying-frequency signal at the point of observation is effected automatically.

621.317.411 1429

A Method of Measuring the Magnetic Permeability of Rod Specimens—H. Aspden. (*Jour Sci. Instr.*, vol. 29, pp. 371–374; Nov. 1952.) Description of a method using a search coil and fluxmeter together with switching arrangements resulting in integration of the effects of repeated reversals of the magnetizing field.

621.317.444 1430

A Rotating-Coil Fluxmeter—M. S. Wills. (*Jour. Sci. Instr.*, vol. 29, pp. 374–376; Nov. 1952.) A small search coil mounted on a flexible shaft is rotated at a constant speed of about 3000 RPM in the unknown field, and the alternating e.m.f. picked up is fed to a transformer primary mounted on the other end of the shaft. The EMF from the fixed secondary of the transformer is amplified and measured by a valve voltmeter, giving absolute readings proportional to the flux linkage.

621.317.71 1431

Combined Current Integrator and Sensitive Microammeter—H. A. Enge. (*Rev. Sci. Instr.*, vol. 23, pp. 599–600; Nov. 1952.) An instrument designed for use with ES accelerators and capable of integrating currents $>10^{-8}$ A has in the integrator input circuit a compensating resistor which acts also as shunt resistor for the tube voltmeter used as microammeter.

621.317.73:621.396.67 1432

Impedance-Measuring Apparatus—M. P. Beddoes. (*Wireless Eng.*, vol. 30, pp. 69–72; March 1953.) Apparatus for measuring the impedance of a VHF antenna incorporates a reflectometer which detects the radiation reflected by a standards unit with and without the antenna connected; by this method the detector does not pick up radiation from the antenna. The frequency range of the particular equipment described is 30–60 mc, but this could be extended to 7–100 mc without difficulty. The accuracy is inversely proportional to the impedance measured, the error being $\geqslant \pm 10\%$ for 1 kΩ.

621.317.733.029.55/.62 1433

High-Frequency Bridge with Variable Ratio Arms—J. E. Houldin and G. T. Thompson. (*Wireless Eng.*, vol. 30, pp. 32–38; Feb. 1953.) The bridge is intended for the measurement of unbalanced impedances, such as antennas and cables, of the order of 100 Ω at frequencies between 10 and 100 mc. In an experimental model described, the variable ratio arms are in the form of a circular arc of transmission line with a movable feed point. The unknown is measured in terms of a standard resistor, two variable capacitors and the ratio of the lengths of the two line sections. The only auxiliary equipment required is a signal generator giving 2 V RMS and a sensitive dc galvanometer. The accuracy depends on the frequency and on the value of the unknown.

621.317.733.083.4 1434

Balance Approach in A.C. Measurement Circuits: Part 2—Wheatstone Bridges—H. Poleck. (*Arch. Tech. Messen*, pp. 259–262; Nov. 1952.) The "convergence factor," a measure of the rate at which a system attains the balance condition, is calculated for a Wheatstone bridge, a potentiometer-type capacitance bridge and a Schering bridge. Part 1: 1660 of 1952.

621.317.74:621.317.34 1435

Two Diagram Methods for Determination of Network Parameters at Very High Frequencies—R. Eichacker. (*Fernmeldetech. Z.*, vol. 5, pp. 487–496; Nov. 1952.) Two methods are described for the direct representation of the impedance, admittance, attenuation, phase, reflection coefficient, etc., of networks in polar or derived diagrams. The complex reflection factor, from which all the parameters can be deduced, is determined from measurements of the voltages picked up, in the first method, by four probes spaced λ/8 apart along a slotted coaxial line terminated by the network in question, and secondly by directional couplers inserted in each half of a symmetrical coaxial system, one half terminated by the network and the other short-circuited, a Rohde & Schwarz "Z-g" diagraph being used to determine the vectorial difference between the voltages picked up by the directional couplers. Details are given of the methods of deriving the various network parameters.

621.317.755 1436

The B.T.R. Frequency-Shift Cathode-Ray Monitor—R. Terlecki. (*Strowger Jour.*, vol. 1 pp. 184–189; Nov. 1952.) Two gating diodes are connected to the cr-tube vertical plates in such a way that the alternation of positive and negative pulses arriving from the receiver discriminator causes the beam to trace a V on the screen. A 5-kc frequency-sweep oscillator is used to broaden the trace so that inequality of the arms, indicative of receiver mistuning, is easily perceptible.

621.317.755:621.314.7 1437

Cathode-Ray Tube Plots Transistor Curves—J. Kurshan, R. D. Lohman and G. B. Herzog. (*Electronics*, vol. 26, pp. 122–127; Feb. 1953.) Detailed description of automatic CRO equipment for displaying families of transistor characteristics; both point-contact and junction types can be handled.

621.317.755:621.397.6.018.7 1438

A Delayed-Trigger Oscillograph—R. Anderson and J. R. Smith. (*Proc. IEE* (*London*), Part IIIA, vol. 99, pp. 581–586. Discussion, pp. 643–650; 1952.) By deriving a trigger pulse from the first of the eight wide pulses in each frame cycle and delaying this pulse by means of a variable delay circuit covering the range 2–22 ms, the variable-speed timebase of the CRO can be fired to enable either a single line or any required portion of the waveform to be displayed. Detailed circuit diagrams of the equipment are given. See also 1762 of 1952 (Fisher).

621.317.757 1439

A Photomechanical Wave Analyser for Fourier Analysis of Transient Waveforms—T. B. Whiteley and L. R. Alldredge. (*Jour. Sci. Instr.*, vol. 29, pp. 358–362; Nov. 1952.) A photoelectric system is used to derive a signal from repetition of the transient wave by means of a revolving drum. The signal is analyzed by application to fixed tuned circuits, the drum speed being gradually reduced so as to obtain a large number of points on the frequency-spectrum curve.

621.317.772:621.392.26 1440

Squeeze-Section Phase Shifter for Microwave Measurements—J. J. Brady, M. D. Pearson and S. Peoples. (*Rev. Sci. Instr.*, vol. 23, pp. 601–604; Nov. 1952.) The device comprises a section of standard 3-cm waveguide with slots 25 in. long and 0.0625 in. wide in the broad faces and a calibrated micrometer head for introducing compression at the mid-point of the slot. A calculation is made of the relative wavelength change as a function of wall displacement. A table of values is given from which calibration curves can be drawn.

621.317.78:[537.312.6:621.316.86 1441

Power Measurement with Thermistors at High Frequencies—H. Groll. (*Fernmeldetech. Z.*, vol. 5, pp. 522–527; Nov. 1952.) Various types of thermistor, including some of the bead type suitable for HF measurements, are described, with illustrations, and also arrangements for power measurements on coaxial lines. The thermistors used have resistances, when cold, of 1–500 kΩ, with power ratings from 1 to 50 mW. For higher powers, thermistors may be connected in parallel with a coaxial line terminated by its characteristic impedance.

621.317.784.029.64/.65 1442

A Microwave Vibration Wattmeter—A. L. Cullen. (*Nature* (*London*), vol. 170, pp. 1121–1122; Dec. 27, 1952.) A method of measuring microwave power is described in which a short magnetic dipole is suspended horizontally at its midpoint by a quartz fiber inside a high-*Q* cavity resonator fed through a waveguide. By repeatedly switching the power on and off, the dipole can be made to oscillate through an angle depending on the frequency, the power applied to the cavity at resonance, and the physical constants of the quartz fibre. The method is independent of the value of *Q* and of the characteristics of the dipole and should therefore be particularly suitable for use at millimetre wavelengths. Tests at a wavelength of 3.2 cm show that a deflection of about 30 cm at a scale distance of 1 m can easily be obtained with a power of 100 mW or less.

621.317.79:621.396.822 1443

The Ogiver, a Radio-Noise Meter—A. W. Sullivan. (*Radio & Telev. News, Radio-electronic Engng Section*, vol. 48, no. 6, pp. 3–5; Dec. 1952.) Description, with detailed circuit diagram, of an instrument for measuring the fraction of time that a noise wave exceeds a prescribed voltage level. The instrument is a development of that described by Hoff & Johnson (1953 of 1952), a closed loop having been added to permit change of the variable to be measured.

621.385.832.001.42 1444

The Life Testing of Cathode-Ray Tubes—R. C. Hart. (*Proc. IEE* (*London*), part IIIA, vol. 99, no. 19, pp. 537–541. Discussion, pp. 571–576; 1952.) An outline of methods used and of safety precautions necessary.

621.396.9:621.317.7 1445

A Compact Radar Test Unit—G. W. Bridger and C. A. Sempers. (*Marconi Instrumentation*, vol. 3, pp. 136–145; Dec. 1952.) Equipment Type-TF890A designed for the 3-cm waveband comprises (a) a signal generator with either *CW* or pulse output at a level continuously variable over a range of 66 db below 1 mW, with a further fixed attenuation of about 50 db available, (*b*) a power monitor, using a thermistor bridge, for measuring RF mean powers up to 50 W, (*c*) a spectrum analyzer using a modulated local oscillator, a mixer and IF amplifier to provide a series of pulses distributed linearly over the transmitter frequency spectrum and proportional to its power at these points. Operation of the equipment is described.

621.396.9.001.4 1446

Measurements relating to [moving-target] Radar Equipment with Fixed-Target-Echo Elimination—J. Cauchois. (*Ann. Radioélect.*, vol. 7, pp. 288–295; Oct. 1952.) The principles of the elimination of echoes from fixed objects are outlined and stability requirements in equipment for moving-target indication are noted. Block diagrams and outline descriptions of CRO methods of measuring frequency drift are given. In the case of the klystron local oscillator, a second stabilized klystron is used to obtain a test-frequency signal which is checked (*a*) by heterodyning in a commercial receiver, (*b*) by a sensitive frequency discriminator centered on 100 kc or (*c*) by a phase comparator operating in conjunction with a stable medium-frequency generator. Methods (*b*) and (*c*) may be adapted for checking the coherent oscillator. Magnetron stability both during and between pulses may be measured on a calibrated wide-band frequency discriminator. A heterodyne method for checking the operation of the local-oscillator/coherent-oscillator assembly is described.

OTHER APPLICATIONS OF RADIO AND ELECTRONICS

534.321.9:623.896 1447

Ultrasonic Recorder Gages Torpedo Depth—C. E. Goodell. (*Electronics*, vol. 26, pp. 118–121; Feb. 1953.) For measuring the depth of a torpedo on a test run, a dummy head is used containing a pulse transceiver and ultrasonic transducer; the depth indication is obtained from the pulses reflected back from the ocean surface and is continuously recorded. A transducer with wide radiation angle is used.

537.565:621.316.729 1448

Two Systems for the Synchronization of Pulsed High-Energy Ion Beams—G. von Dardel, E. Hellstrand and C. Taylor. (*Appl. Sci. Res.*, vol. B3, pp. 35–46; 1952.)

538.24.001.8:621–44 1449

Contour Recording by Magnetic Tape—R.R. Perron. (*Elect. Mfg.*, vol. 47, pp. 130–131; June 1951.) Equipment is described in which a p.w.m. method is used to record, on magnetic tape, a set of pulses representing a particular contour to be reproduced. Reproduction is effected via an amplifier, a flip-flop circuit, and a servo system. Up to 1000 copies can be made, using ordinary coated-paper tape.

621.316.7:621.392.5 1450

Realization of Correction Circuits—V. V. Bulgakov. (*Bull. Acad. Sci.* (*U.R.S.S.*), *tech. Sci.*, pp. 21–40 & 699–723; Jan. & May 1952. In Russian.) Correction circuits used with automatic regulators and servomechanisms for improving their frequency characteristics are considered. All basic types of quadripole section are analyzed. The circuits do not contain mutual inductors, nor, in the majority of cases, ideal elements, i.e. resistance-free inductors or loss-free capacitors. Methods are indicated for selecting quadripole sections so as to realize any given rational function.

621.316.718.5 1451

General Considerations on Electronic Speed Regulators—R. Larguier. (*Ann. Radioélect.*, vol. 7, pp. 279–287; Oct. 1952.) A simplified mathematical treatment to determine design requirements for stability and accuracy. In respect of inertia and friction coefficients these are different from those obtaining in the design of position servomechanisms.

621.365.54† 1452

The High-Frequency Heating of Metals—R. Walchli. (*Bull. Schweiz. Elektrotech. Ver.*, vol. 43, pp. 1015–1028; Dec. 13, 1952.) Illustrated description of the principles and applications of induction heating in soldering, heat treatment, etc.

621.365.55† 1453

High-Frequency Dielectric Heating—A. Goldstein. (*Bull. Schweiz. Elektrotech. Ver.*, vol. 43, pp. 1005–1015; Dec. 13, 1952.) Discussion of the theory of the process in relation to the molecular structure of dielectric materials and description of its application in different industries.

621.384.612 1454

The Strong-Focusing Synchrotron—A New High-Energy Accelerator—E. D. Courant, M. S. Livingston and H. S. Snyder. (*Phys. Rev.*, vol. 88, pp. 1190–1196; Dec. 1, 1952.) Strong focusing is produced by use of alternate converging and diverging magnetic lenses. A design for a 3×10^{10}eV proton accelerator is discussed.

621.384.622.1 1455

Radial Focusing in the Linear Accelerator—J. P. Blewett. (*Phys. Rev.*, vol. 88, pp. 1197–1199; Dec. 1, 1952.) Application to linear accelerators of the focusing mechanism described in 1454 above.

621.385.833 1456

Double Focusing of Charged Particles with a Wedge-Shaped, Non-Uniform Magnetic Field—R. M. Sternheimer. (*Rev. Sci. Instr.*, vol. 23, pp. 629–634; Nov. 1952.)

621.385.833 1457

Electron Microscopy by Reflection—C. Fert and R. Saporte. (*Comp. Rend. Sci.* (*Paris*), vol. 235, pp. 1490–1492; Dec. 10, 1952.) Description of the features of an experimental microscope in which the specimen and the electron beam are inclined slightly to the axis of the objective, for the examination of polished opaque surfaces at nearly grazing incidence of the beam.

621.385.833 1458

Experimental Study of the Electrostatic Immersion Objective with Plane Electrodes—A. Septier. (*Comp. Rend. Acad. Sci.* (*Paris*), vol. 235, pp. 1621–1623; Dec. 22, 1952.)

621.385.833 1459

A Method for the Measurement of Spherical Aberration of an Electrostatic Electron Lens—D. W. Shipley. (*Jour. Appl. Phys.*, vol. 23, pp. 1310–1316; Dec. 1952.)

621.385.833:538.691 1460

Focusing Properties of a Combination of a Radially Decreasing Magnetic Field and a Cylindrical Electric Field—D. Fischer. (*Z. Phys.*, vol. 133, pp. 455–470; Nov. 4, 1952.) Analysis shows that such a field combination produces both radial and axial focusing and is superior in respect of resolving power and intensity to a uniform-field system.

621.387.4 1461

Counter Tubes with Methylene Halides as Vapour Admixture—H. Neuert and H. Gutbier. (*Z. Phys.*, vol. 133, pp. 451–454; Nov. 4, 1952.)

621.387.42 1462

Discharge Mechanism in Argon Counters—L. Colli and U. Facchini. (*Phys. Rev.*, vol. 88, pp. 987–998; Dec. 1, 1952.) A study of the multiplication curves and pulse shapes obtained with counters filled with pure Ar or with mixtures of Ar and CO_2 at pressures from 150 to 1000 mm Hg.

621.387.424 1463

Properties of Argon-Bromine Counters—D. van Zoonen and G. Prast, Jr. (*Appl. Sci. Res.*, vol. B3, no. 1, pp. 1—17; 1952.) The properties of counters using an Ar-Br mixture for quenching are compared with those of counters using an argon-alcohol mixture.

621.387.424 1464

The Apparent Dead Time of a Geiger Counter, measuring an Intensity of Radiation which varies periodically—H. Daams. (*Appl. Sci. Res.*, vol. B3, no. 1, ppl 29–34; 1952.) A formula is derived for correcting the effect of the dead time of a G-M counter when measuring periodically varying radiation. Experiment shows that with increasing frequency of the variation the count goes through a maximum value.

PROPAGATION OF WAVES

538.566:551.510.535 1465

Differential Equation for Electromagnetic Rays in a Nonuniform Ionized Absorbing Medium with Slowly Varying Parameters—H. Arzelies. (*Comp. Rend. Acad. Sci.* (*Paris*), vol. 235, pp. 1619–1621; Dec. 22, 1952.) The notation and results of a previous note (196 of January) are used and a general differential equation for the phase lines is developed. The phase lines coincide with the E.M. rays giving the mean direction of energy propagation. Application of the results to propagation in the ionosphere, where absorption is slight, is discussed briefly.

538.566.2 1466

Reflection of Electromagnetic Waves Obliquely from an Inhomogeneous Medium—J. R. Wait. (*Jour. Appl. Phys.*, vol. 23, pp. 1403–1404; Dec. 1952.) A solution is derived for reflection from a plane boundary between a homogeneous medium and one in which the permittivity varies exponentially with distance from the boundary.

538.566.3:551.510.535 1467

Calculation of Absorption in the Ionospheric Propagation of Short Waves—Bolle and Dominici. (See 1351.)

621.396.11 1468

Some Notes on Theory of Radio Scattering in a Randomly Inhomogeneous Atmosphere—H. Fine. (PROC. I.R.E., vol. 41, p. 294; Feb. 1953.) Booker and Gordon (1757 of 1950) defined an autocorrelation function of permittivity as a space correlation. Staras (N.B.S. Report No. 1662) has proposed the use of a time correlation function and derived an expression for the average received power due to scattering, whereas Booker and Gordon considered the instantaneous power. From practical considerations it would seem that the average power is the more useful, as the instantaneous power fluctuates greatly with time. A third definition of correlation is proposed and discussed, with correlation in the time-space domain.

621.396.11 1469

Graphical Solution of Sky-Wave Problems—R. A. Helliwell. (*Electronics*, vol. 26, pp. 150, 152; Feb. 1953.) A chart is presented which relates great-circle distance, virtual height of reflection, equivalent path distance, angle of departure and angle of incidence at the ionosphere so that any three of these magnitudes can be determined if the other two are known.

621.396.11 1470

New Determinations of the Velocity of Radio Waves—C. I. Aslakson. (*Trans. Amer. Geophys. Union*, vol. 32, pp. 813–821; Dec. 1951.) A new value of 299 794.2±1.4 kmps is deduced for the velocity of propagation of radio waves in vacuo. This value was obtained by comparison of long-distance geodetic measurements with results obtained with improved shoran equipment. A value of 299 793 km has been adopted by the U. S. Air Force for shoran measurements. For previous work see 206 and 2610 of 1950.

621.396.11:551.5 1471

Tropospheric Wave Propagation in a Duct of Non-uniform Height—H. G. Hay and R. S. Unwin. (*Proc. Phys. Soc.*, vol. 65, pp. 981–989; Dec. 1, 1952.) The mode theory of tropospheric refraction presented by Booker and Walkinshaw (2892 of 1947) is extended to cover the case where the refractive-index profile varies along the transmission path, the path being considered as a series of zones within each of which the profile is constant. The duct width and the lapse rate of modified refractive index at infinite height are found for each zone and are used in conjunction with published propagation curves to estimate the field-strength distribution in the region beyond the horizon of a transmitter. Though the method is general, the final formula applies specifically to situations in which the field is adequately described by the first mode alone and the refractive-index profile in each zone is represented by a one-half power law curve. Results obtained by applying the theory are in good agreement with experimental results obtained during an investigation in New Zealand [200 of 1951 (Milnes and Unwin)].

621.396.11:551.510.535:523.746 1472

The Differences in the Relationship between Ionospheric Critical Frequencies and Sunspot Number for Different Sunspot Cycles—Ostrow and PoKempner. (See 1350.)

621.396.11:621.396.81 1473

Statistical Fluctuations of Radio Field Strength far beyond the Horizon—S. O. Rice. (PROC. I.R.E., vol. 41, pp. 274–281; Feb. 1953.) Statistical properties of the fluctuations are derived on the basis of the Booker-Gordon scattering theory. Expressions are obtained for the periods of the fluctuations in time, in space, and in frequency. These expressions extend closely related results obtained by Booker, Ratcliffe and others.

621.396.11.029.51 1474

Oblique Incidence Propagation at 300 kc/s Using the Pulse Technique—J. M. Watts. (*Jour. Geophys. Res.*, vol. 57, pp. 487–498; Dec. 1952.) Data derived from experiments over the 1185-km sea path from Wildwood, New Jersey, to Bermuda during March–June 1951 are presented. Included are photographs of typical pulse envelopes obtained and graphs of (*a*) time-delay differences between surface and sky waves and (*b*) sunrise transition times.

RECEPTION

621.396.82 1475

The Effective Value of Modulated Oscillations—M. Kulp. (*Frequenz*, vol. 6, no. 10, pp. 290–295; Oct. 1952.) Expressions are derived for the RMS values corresponding to various complex am and fm waveforms. Bessel-function relations used in deriving the expressions and in calculating interference with reception (2325 and 2886 of 1952) are listed.

621.396.828:621.395.34 1476

The Suppression of Radio Interference from Telephone Apparatus—A. F. Jones. (*G.E.C. Telecommun.*, no. 15, pp. 36–42; Nov. 1952.) A review, with reference to B.S.I. specifications, of methods recommended for suppression of interference from electrical apparatus, and application of these methods to automatic telephone apparatus.

STATIONS AND COMMUNICATION SYSTEMS

621.39.001.11 1477

Correlation versus Linear Transforms—M. J. E. Golay. (PROC. I.R.E., vol. 41, pp. 268–271; Feb. 1953.) Discussion indicates that while the correlation concept is useful in communication theory, it does not constitute a useful operational concept in communication or radar practice. On the other hand, operation of many systems could possibly be improved by a system based on storage on magnetic tapes of the sign only of the amplitude of signals submerged in noise, with linear transformation and presentation of the transforms at cinematographic speed.

621.39.001.11 1478

"Ideal Coding" versus "Redundancy"—D. A. Bell. (*Wireless Eng.*, vol. 30, pp. 73–74; March 1953.) An examination is made of some implications of Theorem 2 of Shannon's paper on communication in the presence of noise (1649 of 1949). A three-dimensional model showing the power and uncertainty associated with a three-digit signal is used to illustrate discussion of the risk of errors. "Shannon coding" should in principle be more effective than "redundancy" for reducing errors.

621.39.001.11:001.891 1479

Some Problems and Methods of Communications Research—W. Meyer-Eppler. (*Fernmeldetech. Z.*, vol. 5, pp. 514–522; Nov. 1952.) Discussion of various problems of communication theory, mainly from the physical, linguistic and psychological points of view.

621.39.001.11:061.3 1480

Applications of Communication Theory—(*Nature* (*London*), vol. 170, pp. 1051–1053; Dec. 20, 1952.) Summarized report of the proceedings at a symposium at the Institution of Electrical Engineers, London, September 1952, with the limited objective of examining what of practical value had resulted from applying the theoretical work discussed at the previous symposium (981 of 1951) to the problems of electrical communication. The proceedings are to be published by Butterworths Scientific Publications.

621.39.001.11:[621.398+621.317 1481

Modern Signal and Information Theories. Applications to Telecontrol and Measurements—J. Loeb. (*Rev. gén. Élect.*, vol. 61, pp. 499–516; Nov. 1952.) See also 2535 and 3041 of 1951.

621.395.44:621.315.052.63:621.316.7 1482

Frequency-Shift Carrier-Current Equipment for Telemetering and Other Control Functions—R. W. Beckwith. (*Elect. Eng., N. Y.*, vol. 71, pp. 1026–1031; Nov. 1952.) Two circuits are described: (*a*) a Hartley-type oscillator with a 2-crystal network in the grid circuit; frequency shift is effected by a reactance-valve or diode switching circuit and is effectively limited by the crystals to precise predetermined values; (*b*) a highly stable discriminator based on the series and parallel resonance of a crystal in one arm of a bridge circuit.

621.396.41:621.396.619.16 1483

Input Circuit and I.F. Amplifier of 24-Channel Equipment using Pulse-Phase Modulation—H. Behling. (*Fernmeldetch. Z.*, vol. 5, pp. 502–511; Nov. 1952.) A detailed account of the development and performance of equipment for the frequency band 1.9–2.1 kmc, with a mean IF of 120 mc.

621.396.619.13:621.3.018.78 1484

Distortion of a Frequency-Modulated Signal by Small Loss and Phase Variations—F. Assadourian. (*Elect. Commun.*, vol. 29, pp. 314–320; Dec. 1952.) Reprint. See 2027 of 1952.

621.396.65:621.396.41 1485

V.H.F. Trunk Radio in Nyasaland—L. E. Strazza. (*G.E.C. Telecommun.*, No. 15, pp. 3–14; Nov. 1952.) Description of a multichannel f.m. 70–88-mc system operating between twelve principal towns. The total route length is over 330 miles, much of this being over mountainous and difficult terrain.

621.396.931 1486

Problems of Radio Transmission for Mobile Telephony Systems—W. Klein. (*Tech. Mitt. Schweiz. Telegr.-Teleph Verw.*, vol. 30, pp. 331–347; Nov. 1, 1952. In German.) The particular difficulties encountered in a mountainous country like Switzerland are discussed. Results of field-strength measurements in Zürich on frequencies of 36.5 and 160 mc are reported and f.m. and ph.m. systems compared. Technical data for equipment operating in the 80-mc and 160-mc bands are tabulated and the effect of external interference, particularly from motor cars, is investigated in some detail. The possibility of communication with trains is considered and measurements of interference voltages on 200 mc in a train going from Olten to Zürich are shown for the cases in which the measurement equipment was installed (*a*) directly behind the engine, (*b*) at the rear of the train.

621.396.932.029.62 1487

V.H.F. Harbour Radio—J. Mohrmann. (*Telefunken Ztg*, vol. 25, pp. 207–214; Nov. 1952.) Description of the fm communication system operating in the 2-m band at Hamburg and other ports in North Germany. For full duplex working, transmitter and receiver use a common antenna with separating filters. A two-tone selective call system is used.

621.396.97.029.62+621.397.61.029.62]:061.3 1488

The U.S.W. Conference, Stockholm, 1952—E. Augustin. (*NachrTech*, part 10, pp. 289–292; Oct. 1952.) An account of the proceedings, mainly contrasting the rejected Russian proposals with those finally adopted. See also 3560 of 1952 (Stepp).

SUBSIDIARY APPARATUS

621-526 1489

Stability of Control Systems. Study of a Common Type of Equation—J. Kuntzmann, J. Daniel and Min-Yuan Ma. (*Rev. gén. Élect.*, vol. 61, pp. 532–538; Nov. 1952.) See also 2619 of 1952.

621.311.6:621.396.933.2 1490

Converting Direct Voltage to Alternating Voltage at High Power—D. Engberts. (*Electronica*, vol. 5, pp. 177–178; Nov. 8, 1952.) Description of a unit providing a 60-cps supply for a radio beacon at Schiphol. An inverter circuit with balanced Hg-vapor-filled thyratrons is used, and the maximum continuous power output is 600 VA with an overall efficiency of 50%. Considerably higher supply frequencies can be provided by using thyratrons with different gas fillings.

621.317.733:621.311.6 1491

Use of a Bridge Circuit for supplying Several Loads independently from a Common Voltage Source—W. Hübner. (*Arch. tech. Messen*, pp. 285–277; Dec. 1952.) A circuit suitable for measurement purposes and adapted for both dc and ac supplies has the source arranged in one arm of a bridge and two loads respectively in the two diagonals. Modification to accommodate more loads is indicated.

TELEVISION AND PHOTOTELEGRAPHY

621.397.2 1492

Improvements effected in Facsimile Equipment—M. Frank. (*Ann. Geofis.*, vol. 5, pp. 441–458; July 1952.) Modifications to the apparatus previously described (237 of 1951) are fully discussed. Changes in circuit design include the derivation of the synchronous-motor frequency by division from the subcarrier, and a comparator unit at the receiving end to maintain a constant phase relation between subcarrier and receiver oscillator frequencies.

621.397.5:535.623/.624 1493

Colour Television—L. C. Jesty. (*Nature (London)*, vol. 170, pp. 1094–1097; Dec. 27, 1952.) Report of a discussion on visual problems in television, at a meeting of the Physical Society Colour Group, May 1952.

621.397.5(083.74) 1494

Factors affecting the Choice of Television Channels and Standards in South American Countries—J. P. Arnaud. (*Rev. Tele. Electronica (Buenos Aires)*, vol. 41, pp. 563–569, 573; Sept. 1952. Discussion, *ibid.*, vol. 41, pp. 696–697; Oct. 1952.) FCC standards are discussed. The significance of effective radiated power, frequency, distance, aerial height, terrain and meteorological aspects are considered in relation to the choice of frequency bands. For South America, use of the lowest FCC band is recommended, providing 5 channels of 6 mc width between 54 and 88 mc.

621.397.62 1495

The British Television Receiver—A. J. Biggs and E. O. Holland. (*Proc. IEE (London)*, part IIIA, vol. 99, pp. 577–590. Discussion, pp. 645–650; 1952.) "An account of the typical British domestic television receiver of the present day. During the last two or three years, intensive development has resulted in a product which is basically simple yet capable of refined performance. The general arrangement of a receiver and its controls is described. Some of the background of circuit development is given with reference to the detailed technical aspects. More attention is paid to considerations involved in such matters as the video stage, vision- and sound-interference limiters, synchronizing-signal separation and radiation from line timebases. An account of the steps that have to be taken to render a receiver safe is included. Where possible, design trends of the near future are indicated." 35 references.

621.397.62 1496

A Consideration of Some Factors influencing the Design of Television Receivers for Mass Production—M. Reed, A. B. Atkinson and D. S. Clarke. (*Proc. IEE (London)*, part IIIA, vol. 99, pp. 624–630. Discussion, pp. 645–650; 1952.) Three main aspects of design are considered: (*a*) circuit arrangements which take account of the effect of stray couplings on performance and of tolerance variations in mass-produced components; (*b*) mechanical constructions permitting a high production rate together with adequate flexibility for the production of different types of receiver; (*c*) cabinet construction giving ease of assembly and maximum accessibility for servicing.

621.397.62 1497

Design Considerations for Combination UHF and VHF Receivers—W. B. Whalley. (*Tele-Tech*, vol. 11, pp. 36–38, 110; Nov. 1952.) Choice of IF and different designs of UHF tuning unit are particularly discussed. Suitable UHF valves are noted with references to their use in the various receiver units. Converter design is briefly considered.

621.397.62 1498

On Overcoming the Non-Interlacing of Television Receivers Which Are Accurately Synchronized—G. B. Townsend. (*Proc. IEE (London)*, part IIIA, vol. 99, no. 19, pp. 643–645. Discussion, pp. 645–650; 1952.) The principal cause of incorrect interlacing is found to be variation in the amplitude of the frame flyback. Means of reducing this variation are suggested and a circuit giving constant-amplitude flyback is described which can be applied in the majority of domestic receivers.

621.397.62 1499

Flywheel Synchronization—B. T. Gilling. (*Wireless World*, vol. 59, pp. 137–140; March 1953.) A simple method of providing automatic control of receiver synchronization is described, using a double-diode frequency discriminator.

621.397.62 1500

D.C. Restoration in Television—W. T. Cocking. (*Wireless World* vol. 59, pp. 102–107; March 1953.) An explanation is given of the way in which the dc component is lost when the composite video signal is passed through the RC coupling between the video stage and the synchronizing-signal separator of a standard receiver. The use of a diode to restore the dc level is described, with numerical illustrations; this diode is normally constituted by the grid-cathode path of the pentode used as separator.

621.397.62:535.623 1501

Compatible Color TV Receiver—K. E. Farr. (*Electronics*, vol. 26, pp. 98–104; Jan. 1953.) Description of a 42-tube receiver designed for the N.T.S.C. system, with details of the various sections and explanation of their operation, and with a complete circuit diagram. Its performance on monochrome transmissions is comparable to that of current monochrome receivers.

621.397.62:621.314.63 1502

The Applications of the "Metal Rectifier" in Television Receivers—A. H. B. Walker. (*Proc. IEE (London)*, part IIIA, vol. 99, pp. 560–571. Discussion, pp. 571–576; 1952.) A direct comparison is made between the d.c. characteristics of Se and thermionic rectifiers, the importance of the correct choice of rectifier and working point is stressed, and applications of Se and Cu_2O rectifiers in television-receiver circuits are described.

621.397.62:621.385 1503

Television Valves and the A.C./D.C. Receiver—S. N. Doherty, E. Jones and B. R. Overton. (*Proc. IEE (London)*, part IIIA, vol. 99, no. 19, pp. 524–536. Discussion, pp. 571–576; 1952.) An examination is made of the features of the design of television receivers which are affected by the use of an ac/dc power supply. The tube requirements of each stage are studied and the characteristics of a suitable range of tubes are outlined. Detailed circuit diagrams are given of four typical receivers, a narrow-angle-tube receiver and two wide-angle-tube receivers for the British 405-line system, and a wide-angle-tube receiver for the continental 625-line system.

621.397.62:621.396.621.54 1504

The Design of a Superheterodyne Receiver for Television—D. H. Fisher, P. A. Segrave and A. J. Watts. (*Proc. IEE (London)*, part IIIA, vol. 99, no. 19, pp. 609–623. Discussion, pp. 645–650; 1952.) Discussion of the factors affecting the complete specification and design of RF and IF amplifiers for use in television receivers for the British system and also for the systems adopted in Europe and the U.S.A. The choice of the IF, and the determination of the optimum frequency response are considered, and choice of valves and problems of gain control discussed. A method of obtaining the recommended characteristics in mass-produced receivers is described and an outline specification is given of visual-alignment equipment for production use.

621.397.62:621.396.622.63:546.289 1505

The Use of the Germanium Rectifier in Television Receivers—R. T. Lovelock. (*Proc. IEE (London)*, part IIIA, vol. 99, no. 19, pp. 551–559. Discussion, pp. 571–576; 1952.) Discussion of the use of Ge rectifiers in high-voltage-level and low-voltage-level television rectifier, mixer, and interference-suppression circuits. The performance to be expected from available commercial types of rectifier is indicated.

621.397.62:621.396.662:621.396.611.4 1506

Cavity Tuner for U.H.F. Television—H. Fogel and S. Napolin. (*Electronics*, vol. 26, pp. 101–103; Feb. 1953.) The tuner incorporates three cavity elements, two for the channel selector and the third for the local oscillator. Each element comprises a section of coaxial line with capacitive tuning controlled by plunger.

621.397.621:621.396.615.17 1507

Frame-Scanning Output Circuits for Wide-Angle Cathode-Ray Tubes—D. H. Covill. (*Proc. IEE (London)*, part IIIA, vol. 99, no. 19, pp. 603–608. Discussion, pp. 645–650; 1952.) Comparison of two basic types of deflector coil shows that the type using a slotted core is considerably more efficient for frame scanning. Analysis of transformer-coupled scanning circuits indicates that the lowest value of transformer-primary inductance should be that which corresponds to zero rate of change of anode current at the beginning of the scan. Various linearizing circuits are discussed and a complete frame timebase for scanning a 16-in. CR tube with a 70° deflecting angle and final-anode voltage of 13 kV is described, with full circuit details.

621.397.7 1508

The 100-kW E.R.P. Sutton Coldfield Television Broadcasting Station—P. A. T. Bevan. (Proc. I.R.E., vol. 41, pp. 196–218; Feb. 1953.) Detailed description of the complete installation, which represents the basic general arrangement at later stations, where certain variations are introduced. See also 854 of 1952 (Bevan & Page).

621.397.7 1509

Brief Survey of the Television Installation of Radio Basle—(*Bull. schweiz. elektrotech. Ver.*, vol. 43, pp. 1028–1035; Dec. 13, 1952.) The service area of the transmitter, the arrangement of the station and the operating conditions are described. The vision signal is conveyed by radio link from the studios at Münchenstein to the transmitter site at Gempenfluh 4 km away, where it is reradiated by a 500-W am transmitter on 62.25 mc. Fm is used for the sound channel. Short descriptions are given of the studio and camera, the control room, and the transmitter installation on the Gempenfluh.

621.397.8 1510

Wenvoe Service Area—(*Wireless World*, vol. 59, p. 107; March 1953.) A population of nearly 4.5 million is served by this 50-kW television transmitter brought into service in December 1952. A map shows field-strength contours estimated from measurements on the 5-kW stand-by transmitter.

621.397.82 1511

The Performance of Television Receiver Installations in the Presence of Interference—A. J. Biggs and R. A. Mills. (*Proc. IEE* (*London*), part IIIA, vol. 99, no. 19, pp. 597–602. Discussion, pp. 645–650; 1952.) Test results, for 10 different receivers, on the pickup of interference by the aerial system and receiver circuits, and on the susceptibility to mains-borne interference, indicate that the performance of the average British commercial receiver is satisfactory and that changes to achieve interference immunity do not involve radical modifications of receiver design.

621.397.9 1512

A Survey of some Television Applications for Industry, Scientific Research, and Education—J. E. Telfer. (*Proc. I.R.E.* (*Australia*), vol. 13, pp. 407–416; Dec. 1952.)

TRANSMISSION

621.396.611.21:621.3.016.352 1513

Methods for Improving the Frequency Stability of Transmitters—W. Herzog. (*Telefunken Ztg*, vol. 25, pp. 257–264; Nov. 1952.) Methods considered are the use of (*a*) two crystals in a bridge circuit, (*b*) a compensating resistance, (*c*) a second valve increasing the mutual conductance of the oscillator. A circuit is described from which two different frequencies can be derived according to the polarity of the coupling transformer. See also 80 and 2734 of 1952.

621.396.619.2:621.314.7 1514

The Transistor as Modulator—(*Radio Tech. Dig., Édn franç.*, vol. 6, no. 5, pp. 247–259; 1952.) An account of the frequency modulator described by Koros & Schwartz (3147 of 1951), together with brief details of amplitude modulators described in "The Transistor," published by Bell Laboratories, 1951.

TUBES AND THERMIONICS

621.314.362+621.314.7 1515

Germanium Crystal Valves—R. T. Lovelock. (*G.E.C. Telecommun.*, pp. 29–35; Nov. 1952.) An account of the operating principles and development of point-contact- and junction-type Ge units.

621.314.7 1516

Large Current Amplifications in Filamentary Transistors—W. van Roosbroeck. (*Jour. Appl. Phys.*, vol. 23, pp. 1411–1412; Dec. 1952) A formula is derived for the current multiplication factor α_e of the transistor, and its significance is discussed by considering limiting cases. Possible ways of increasing α_e are indicated.

621.383.27+621.385.15 1517

A Simple Activation for BeCu Multipliers—F. J. FitzOsborne. (*Canad. Jour. Phys.*, vol. 30, pp. 658–659; Nov. 1952.) A multiplication factor comparable with that resulting from more complicated methods is obtained by heating the plates to about 650° C in an inert gas

621.383.27 1518

Investigation of the Dark Current of Photocells with Secondary-Electron Multiplication—N. Schaetti and W. Baumgartner. (*Helv. Phys. Acta.*, vol. 25, pp. 605–611; Nov. 1, 1952. In German.) The increase in dark current and the improvement of sensitivity to red light after each illumination of Li-Sb and Cs-Sb photocathodes indicates that the work function of the cathode is lowered by illumination, resulting in an increase of thermal emission. The change in cathode emission after irradiation alternately with blue and red light is comparable with that of infrared-irradiated phosphors.

621.383.27 1519

Remodulation in Electron Multiplier Cascades—H. E. Kallmann. (Proc. I.R.E., vol. 41, pp. 282–283; Feb. 1953.) Increase of the originally low depth of modulation in a cascade type of electron multiplier is obtained by taking the modulation voltage from an intermediate dynode and applying it to a control grid following a later dynode. Results of tests of the method are reported.

621.383.27 1520

A Practicable Form of Infrared-Sensitive Multiplier—W. Baumgartner and N. Schaetti, (*Helv. Phys. Acta*, vol. 25, pp. 611–615; Nov. 1, 1952. In German.) Measurements are reported on a photomultiplier cell having a Li-Sb cathode and with a Ce-Sm phosphor layer on the outside of the glass wall of the cell. Sensitivity is a maximum at a wavelength of 1.05 μ; its value is about 50 times less than that for a Cs_2O cathode, but the dark current at the first dynode of the multiplier is 10^{-14} A compared with 10^{-11} A for a similar Cs_2O cathode.

621.385:621.397.62 1521

Cathode-Ray Tubes and Valves for Television Receivers—J. D. Stephenson, F. H. Powell, T. W. Price and F. M. Walker. (*Proc. IEE* (*London*), part IIIA, vol. 99, no. 19, pp. 479–498. Discussion, pp. 571–576; 1952.) A survey of progress in Great Britain in the design and manufacture of tubes and CR tubes specially for television receivers, from the early days of the art and particularly since 1945. Mechanized production methods have been developed giving production speeds rivalling those of any other country.

621.385:621.397.62 1522

Television Valves and the A.C./D.C. Receiver—Doherty, Jones and Overton. (See 1503.)

621.385.029.6+621.396.677 1523

Attenuation of Wire Helices in Dielectric Supports—R. W. Peter, J. A. Ruetz and A. B. Olson. (*RCA Rev.*, vol. 13, pp. 558–572; Dec. 1952.) Attenuation curves are presented for the range 2.6–3.6 kmc. Attenuation increases linearly with frequency and nearly linearly with the ratio of free-space velocity to phase velocity; it has a very flat minimum at a wire-diameter/pitch ratio of 1/3 and varies as the square root of the resistivity of the metal which forms the helix surface. Of the dielectric supports investigated, 707 precision-bore glass tubing showed the highest loss. Quartz tubing is better, but fluted 707 glass tubing causes the lowest loss, as it supports the helix at only three points of the circumference.

621.385.029.63/.64 1524

New Developments in Traveling-Wave Tubes—W. J. Dodds, R. W. Peter and S. F. Kaisel. (*Electronics*, vol. 26, pp. 130–133; Feb. 1953.) Descriptions are given of a low-noise wide-band tube for operation at 3 kmc [see also 277 of January (Peter)] and of a medium-power type for operation in commercial relay equipment at about 2 kmc. The latter has a length only slightly over 7 in. Narrow-band types are described in which the helix is modified to act as a filter, and the possibility of using focusing magnets as for radar magnetrons is briefly indicated.

621.385.029.63/.64 1525

Notes on the Influence of the Plasma Oscillation in Transit-Time Valves—F. Lüdi. (*Z. Angew. Math. Phys.*, vol. 3, pp. 390–393; Sept. 15, 1952.) According to the theory of the traveling-wave tube previously developed [1518 of 1951 (Frey and Lüdi)], the plasma oscillation is of importance in klystron and double-beam tubes, but not in the traveling-wave tube. This last conclusion does not agree with the results of other workers [3166 of 1951 (Warnecke et al.)]; the theory is re-examined and an explanation for the discrepancy is advanced.

621.385.029.63 1526

Experimental Study of the Interaction of Space-Charge Waves within an Electron Beam moving in Crossed Electric and Magnetic Fields—P. Guénard and H. Huber. (*Ann. Radioélect.*, vol. 7, pp. 252–278; Oct. 1952.) Detailed account of experiments noted earlier [278 of January and 904 of March (Warnecke et al.)] in an investigation of (*a*) amplification, (*b*) oscillations, and (*c*) other effects due to space-charge waves in crossed-field tubes. Specially constructed tubes were used. The presence of an auxiliary anode in the interaction space increases both the gain and the rise in gain as current is increased. Diocotron oscillation frequencies are in agreement with simple theory based on a square-law distribution of space charge. Results of measurements on a tube with interdigital-type anode indicate a Maxwellian distribution of electron energy with considerable thermal agitation; an empirical formula for the negative-electrode or "sole" current is similar in form to that for diocotron gain. The importance of the diocotron effect is emphasized and anomalies in magnetron theory in respect of efficiency and gain are explained. 45 references.

621.385.032.216 1527

An Experimental Investigation of an Oxide-Coated Cathode—N. D. Morgulis and Ya. P. Zingerman. (*Comp. Rend. Acad. Sci.* (*U.R.S.S.*) vol. 81, pp. 783–785; Dec. 11, 1951. In Russian.) An investigation of the potential gradient through the coating.

621.385.032.216 1528

Studies of the Oxide Cathode—L. S. Nergaard. (*RCA Rev.*, vol. 13, no. 4, pp. 464–545; Dec. 1952.) A review article, with 64 references, discussing known phenomena associated with BaO cathodes, reporting new experimental work and suggesting a hypothesis to account for the experimental results. This hypothesis assumes that the cathode has mobile donors uniformly distributed in the oxide when no current is being drawn. When current is drawn, electrolysis occurs in the oxide layer and the donors migrate towards the base, leaving a donor depletion layer near the emitting surface. This layer has properties approaching those of the intrinsic material. Under equilibrium conditions electrolysis is balanced by back diffusion. Evidence that the donors may be F centers formed from oxygen vacancies is adduced. Energy levels are computed. A diode with BaO-SrO cathode which can be operated as an amplifier is incidentally described.

621.385.032.216 1529

Photoconductivity Study of Activation of Barium Oxide—H. B. DeVore. (*RCA Rev.*, vol. 13, pp. 453–463; Dec. 1952.) The long-wavelength tail of the photoconductivity curve has, for increasing cathode activation, thresholds at about 2.3 and 1.4 eV. These indicate the development of donors at these levels below the conduction band. Two possible explanations are considered.

621.385.032.216:621.396.822 1530

Noise in Interface Resistance—H. O. Berktay. (*Wireless Eng.*, vol. 30, pp. 48–49; Feb. 1953.) A brief note pointing out that the noise resistance of a tube with oxide cathode is related to the impedance between coating and core of the cathode.

621.385.032.216:621.396.822 1531

On the Flicker Noise Caused by an Interface Layer—W. W. Lindemann and A. van der Ziel. (*Jour. Appl. Phys.*, vol. 23, pp. 1410–1411; Dec. 1952.) Measurements on Type-6SJ7 pentodes are reported.

621.385.032.216:621.396.822 1532

Excess Thermal Noise Due to Current Flow through (BaSr) Oxide Coating—K. Amakasu. (*Jour. Appl. Phys.*, vol. 23, pp. 1330–1332; Dec. 1952.) Experimental results indicate that (*a*) the excess noise due to the passage of the current is proportional to the square of the current, (*b*) the noise intensity is inversely proportional to the frequency, (*c*) the noise depends greatly on the activation of the cathode.

621.385.3 1533

Current Division in Plane Positive-Grid Triode—S. Deb. (*Indian Jour. Phys.*, vol. 26, pp. 377–392; Aug. 1952.) The openings between the grid wires are assumed to act as thin cylindrical lenses free from aberration. Formulas are derived for the cases of (*a*) reflection and (*b*) no reflection of electrons from the anode. For (*a*) the formula is identical with that of Jonker (2087 of 1946); for (*b*) the expressions given by Spangenberg (3417 of 1940) and by Jonker and Tellegen (2087 of 1946) follow as special cases.

621.385.3 1534

Potential Distribution for Space-Charge-Limited Current between a Plane Accelerating Grid and Parallel Anode—E. G. Ramberg and L. Malter. (*Jour. Appl. Phys.*, vol. 23, no. 12, pp. 1333–1335; Dec. 1952.) Expressions are derived based on the assumption of a Maxwellian distribution of electron velocities. The distribution is determined by Langmuir's diode functions in combination with a function depending on the current in the grid-to-anode space, which is represented graphically.

621.385.3.029.62 1535

Siemens U.S.W. and Television Transmitting Valves—W. Müller. (*Fernmeldetech. Z.*, vol. 5, pp. 528–533; Nov. 1952.) An account of the development and construction of a series of air cooled disk-seal triodes: Types RS 1021, RS 1071 and RS 1011 for 220 mc, and Type RS 1001 for 100 mc. Output powers are respectively 1.25, 5, 12 and 11 kW, and characteristic slopes 30, 40, 60 and 40 mA/V.

621.385.3.029.63 1536

U.H.F. Triode Design in Terms of Operating Parameters and Electrode Spacings—L. J. Giacoletto and H. Johnson. (Proc. I.R.E., vol. 41, pp. 51–58; Jan. 1953.) Graphs are constructed by means of which the ratio between grid input conductance and transconductance can be determined approximately from the geometrical data; from this ratio the RF gain and noise factor are found by means of further graphs. The possibility of effecting improvements by changing design parameters is studied. The performance predicted by the approximate theory given agrees satisfactorily with experimental results obtained by other workers.

621.385.3.029.64 1537

Synthetic Study on Amplification Constants of Triodes—Y. Koike and S. Yamanaka. (*Technol. Rep. Tohoku Univ.*, vol. 16, no. 1, pp. 1–7; 1951.) Continuation of work noted in 3287 of 1952. Planar and cylindrical systems are studied both theoretically and experimentally, using large-scale models in a water tank. The formula previously obtained is confirmed and the correspondence between the two configurations is indicated.

621.385.4/.5:621.396.822 1538

The Limiting Sensitivity of Amplifier Valves: Part 2—Theory of the Screen-Grid Valve—H. Rothe and E. Willwacher. (*Arch. Elekt. Übertragung*, vol. 6, pp. 493–498; Dec. 1952.) The noise figure of a screen-grid tube is regarded as composed of two terms, F_{tr} and F_{v}. F_{tr} is the contribution due to the tube connected as a triode, with screen and anode strapped; its value was determined in part 1 [1203 of April (Rothe)]. F_{v} results from the actual division of current between screen and anode, and depends on the input admittance, which in turn is strongly influenced by the cathode inductance. The analysis is based on the equivalent circuit of the valve incorporated in a tuned HF amplifier.

621.385.832 1539

Development of an Improved Graphechon Storage Tube—W. T. Dyall, G. R. Fadner and M. D. Harsh. (*RCA Rev.*, vol. 13, pp. 546–557; Dec. 1952.) More accurate alignment and the addition of a target shield ring reduce position errors and double the signal/noise ratio. See also 2061 of 1949 (Pensak).

621.385.832:621.397.62 1540

Design Factors in Television Cathode-Ray Tubes—L. S. Allard. (*Proc. IEE* (*London*), part IIIA, vol. 99, no. 19, pp. 499–507. Discussion, pp. 571–576; 1952.) Tube size, beam focusing and deflection systems are discussed, and the electron optics of CR tube guns is considered in detail, both direct-vision and projection-type tubes being treated.

621.385.832:621.397.62 1541

A Univoltage Electrostatic Lens for Television Cathode-Ray Tubes—C. T. Allison and F. G. Blackler. (*Proc. IEE* (*London*), part IIIA, vol. 99, no. 19, pp. 508–513. Discussion, pp. 571–576; 1952.) Discussion shows that it may be possible to produce television CR tubes for operation with the focusing electrode connected to the cathode, if a minimum final-anode potential of 12 kV is adopted. Measurements on experimental tubes, which are described, indicate that the best value of the focus potential is zero, with a final-anode potential of 14 kV, a first-anode potential of 300 V and a beam current of 250 μA.

621.387 1542

Ignition, Discharge and Deionization Processes in Gas Triodes—E. Knoop. (*Z Angew. Phys.*, vol. 4, no. 10, pp. 386–390; Oct. 1952.) Continuation of investigation noted in 3212 of 1950 (Knoop & Kroebal). The time taken for the main (cathode/anode) discharge to develop from the preliminary (grid/anode) discharge depends on the intensity of the ion current to the grid, which in turn depends on grid resistance and bias. Deionization time was measured for triodes with various gas fillings; this also depends on grid resistance and bias, and decreases with increasing grid current because of the increased rate at which the grid space-charge layer spreads into the plasma.

621.396.615.141.2 1543

Determination of the Natural Oscillations and Mode Changes of a Multicavity Magnetron Oscillator—A. Leblond, J. Nalot and O. Doehler. (*Compt. Rend. Acad. Sci.* (*Paris*), vol. 235, pp. 1494–1496; Dec. 10, 1952.) Regarding the magnetron anode as a section of a plane transmission line of periodic structure closed on itself, the natural oscillations of a cavity correspond to points of intersection of certain straight lines with the retardation-factor/wavelength characteristic of the line [3615 of 1952 (Guénard et al.)]. The abscissae of these points define the resonance wavelengths, and the ordinates the beam velocities at which synchronization may occur, a "jump" to another mode being likely if the ordinates are close together. A graph of this kind is useful in the first stage of the design of new magnetrons.

621.396.615.142.2 1544

A Floating-Drift-Tube Klystron—M. Chodorow and S. P. Fan. (Proc. I.R.E., vol. 41, no. 1, pp. 25–31; Jan. 1953.) 1951 I.R.E. National Convention paper. A theoretical and experimental investigation is made of the type of klystron having a single cavity and two gaps separated by a drift tube whose potential is independently controlled, so that it is useful as a f.m. oscillator. The theory is similar to that of the reflex klystron, but the design is inherently capable of giving greater efficiency and power output. By varying the cavity shape it is possible to obtain either high efficiency at low bandwidth (22%, 4 mc) or lower efficiency with greater bandwidth (6%, 15 mc).

621.396.615.142.2:621.396.619.13 1545

F.M. Distortion in Reflex Klystrons—R. L. Jepson and T. Moreno. (Proc. I.R.E., vol. 41, pp. 32–36) Jan. 1953.) The harmonic distortion introduced by a frequency-modulated reflex klystron is computed by expanding in a power series the expression giving frequency as a function of reflector voltage and relating the coefficients of this series to the harmonic distortion components. Design for low distortion is briefly discussed. A method of measuring the distortion components is described; results are in good agreement with the computed values. The distortion is low enough for the tube to be useful in many transmitters and relay applications.

621.396.615.142.2:621.396.65.029.64 1546

Reflex Klystrons for Centimeter Links—A. H. Beck and A. B. Cutting. (*Proc. IEE* (*London*), part IIIA, vol. 99, pp. 357–366. Discussion, pp. 472–478; April/May, 1952.) "The development of reflex-klystron oscillators suitable for use as FM transmitter tubes in links operating in the 3.6–4.2 kmc band is described; details of the performance in this and neighboring bands are given. Since the valves use the copper/glass construction with external resonant circuits, their use is not limited to the applications described."

MISCELLANEOUS

621.38(061.4) 1547

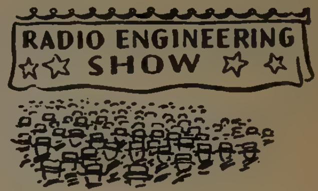
British Electronic Instruments in Research and Industry—J. A. Saxton. (*Nature* (*London*), vol. 170, pp. 877–878; Nov. 22, 1952.) A note on the many different kinds of instruments at the exhibition in London, Sept. 1952, arranged by the Scientific Instrument Manufacturers' Association of Great Britain, with an outline of the subjects discussed in the papers presented at the symposium associated with the exhibition.

621.39:68 1548

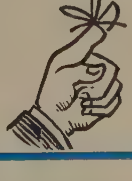
Pioneer Industrial Activity in High-Frequency Technology—G. Guanella, F. Jenny and P. Waldvogel. (*Bull. Schweiz. Elektrotech. Ver.*, vol. 43, no. 20, pp. 834–840; Oct. 4, 1952.) Illustrated account of developments in Switzerland in the production of various types of transmitting valves and equipment for beam radio-communication systems.

“A Preview of Progress”

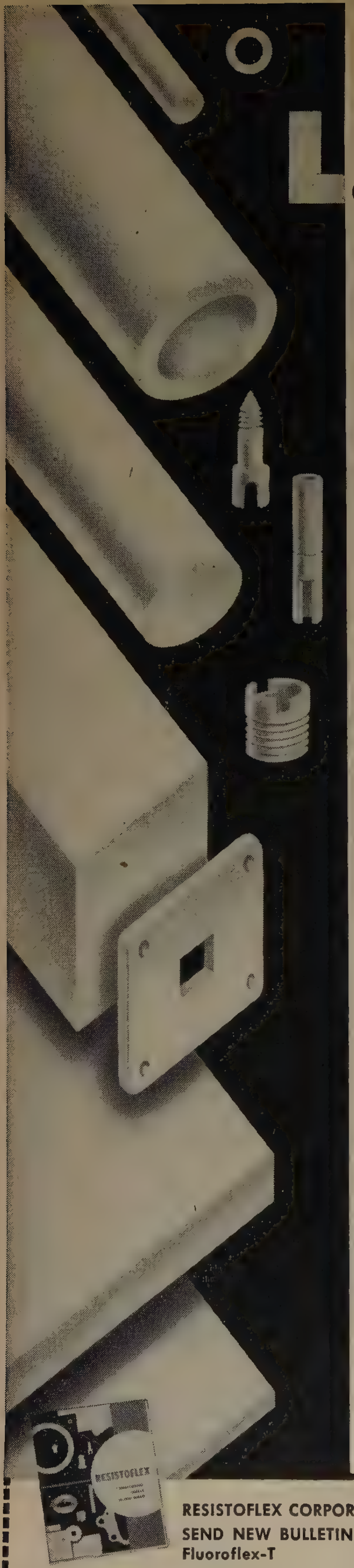
Illinois U Library



is the theme of the 1953 IRE Convention and Radio Engineering Show March 23-26 in New York City. Once again IRE members and visiting radio-electronic firm executives, probably more than 30,000 of them, will come to Grand Central Palace and the Waldorf-Astoria Hotel, to learn what Radio-Electronics has in store for the industry. As in past meetings, both new research and practical engineering will be revealed in vital technical papers, but this year entirely organized by the IRE Professional Groups—making this 18 Conventions rolled into 1. Do not fail to act early on your hotel reservation and reserve space at the fun parts—the IRE Banquet and the Cocktail Party. There is fun for the ladies too, so bring “her” with you. Four floors of exhibits by more than 400 Exhibitors. Remember—you have a date with IRE in New York, coming March 23-26!



Proceedings of the I.R.E. January, 1953, Vol. 41, No. 1. Published monthly by the Institute of Radio Engineers, Inc., at 1 East 79 Street, New York 21, N.Y. Price per copy: members of the Institute of Radio Engineers $1.00; non-members $2.25. Yearly subscription price: to members $9.00; to non-members in United States, Canada and U.S. Possessions $18.00; to non-members in foreign countries $19.00. Entered as second class matter, October 26, 1927, at the post office at Menasha, Wisconsin, under the act of March 3, 1879. Acceptance for mailing at a special rate of postage is provided for in the act of February 28, 1925, embodied in Paragraph 4, Section 412, P. L. and R., authorized October 26, 1927.


Look to

FLUOROFLEX†-T

for

TEFLON*

with the optimum performance you're looking for

"Teflon" powder is converted into Fluoroflex-T rod, sheet and tube under rigid control, on specially designed equipment, to develop optimum inertness and stability in this material. You can be sure of ideal, low loss insulation for uhf and microwave applications... components which are impervious to virtually every known chemical... and serviceability through temperatures from −90°F to +500°F.

Produced in *uniform* diameters, Fluoroflex-T rods feed properly in automatic screw machines without the costly time and material waste of centerless grinding. Tubes are concentric—permitting easier boring and reaming. Parts are free from internal strain, cracks, or porosity. This means fewer rejects, longer service life.

Mail in the coupon for more data.

**Du Pont trade mark for its tetrafluoroethylene resin. †Fluoroflex is a Resistoflex registered trade mark for products made from fluorocarbon resins.*

RESISTOFLEX

RESISTOFLEX CORPORATION, Belleville 9, N. J. 1-1

SEND NEW BULLETIN containing technical data and information on Fluoroflex-T

NAME...TITLE.................................

COMPANY...

ADDRESS...

Meetings with Exhibits

● As a service both to Members and the industry, we will endeavor to record in this column each month those meetings of IRE, its sections and professional groups *which include exhibits.*

Δ

January 26, 27, 1953

1953 7th Regional IRE Conference, University of New Mexico, Albuquerque, N.M.

Exhibits: Hoyt Westcott, 107 So., Washington St., Albuquerque, N.M.

Chairman: C. W. Carnahan, 3169 41st Place, Sandia Base, Albuquerque.

Δ

February 5, 6 & 7, 1953

Southwestern IRE Conference Plaza Hotel, San Antonio, Tex.

Exhibits: M. B. Lampl, Box IRE, St. Mary's University, San Antonio, Texas

Δ

March 23, 24, 25 & 26, 1953

Radio Engineering Show Grand Central Palace, New York City

Exhibits Manager: Wm. C. Copp, 303 W. 42nd St., New York 36, N.Y.

Δ

April 11, 1953

NEREM—New England Radio Engineering Meeting, University of Connecticut, Storrs, Conn.

Exhibits: H. W. Sundius, The Southern New England Tel. Co., 227 Church St., New Haven, Conn.

Δ

April 18, 1953

Spring Technical Conference of the Cincinnati Section, Cincinnati, Ohio

Exhibits: R. W. Lehman, Baldwin Piano Co., 1801 Gilbert Ave., Cincinnati 2, Ohio

Δ

May 11, 12 & 13, 1953

National Conference on Airborne Electronics Hotel Biltmore, Dayton, Ohio.

Exhibits: Paul Clark, 120 West Second St., Dayton 2, Ohio.

Δ

August 19, 20, 21, 1953

1953 Western Electronics Show and Convention, Civic Auditorium, San Francisco, Calif.

Exhibits: Heckert Parker, 1355 Market St., San Francisco 3, Calif.

Δ

September 28, 29 & 30, 1953

National Electronic Conference Hotel Sherman, Chicago.

Exhibits: Orville Thompson, c/o DeForrest's Training Inc., 2735 N. Ashland Ave., Chicago 14, Ill.

NEW! FOR VHF–UHF

PRD type 907 sweep frequency generator

FREQUENCY RANGE:
35 TO 900 MEGACYCLES

•

MINIMUM OUTPUT VOLTAGE:
1 VOLT

•

DIRECT READING FREQUENCY DIAL:
CONTINUOUSLY VARIABLE

•

OUTPUT IMPEDANCE:
75 OHMS-BNC CONNECTOR

•

MINIMUM SWEEP WIDTH ABOVE 60 MC/S:
20 MC/S

The Type 907 is a fundamental oscillator which can be swept in frequency over a band of not less than 10 mc/s for a center frequency of 35 mc/s. The sweep width is greater than 20 mc. for carrier frequencies above 60 mc/s. Output is continuously variable over a voltage range of 10 microvolts to 1 volt. Other features include a video blanking circuit for providing a true horizontal zero base line and a terminal for inserting external frequency markers.

For further information concerning this instrument and additional UHF-VHF equipment, address inquiries to Dept. R-I.

Are you on our mailing list to receive "PRD REPORTS"?

Polytechnic RESEARCH & DEVELOPMENT COMPANY • Inc
55 JOHNSON STREET, BROOKLYN 1, NEW YORK

WESTERN SALES OFFICE:
741½ NO. SEWARD ST.
HOLLYWOOD 38, CALIF.

NEWS and NEW PRODUCTS

January 1952

Tape Recorder

Allied Radio Corp., 833 W. Jackson Blvd., Chicago 7, Ill., is offering a low-priced Knight tape recorder with many new features for a variety of applications. Operating functions include fast forward, fast reverse playback, stop, and record.

The fast forward speed enables the user to locate quickly that portion of the recording desired for playback. Two speeds and dual-track recording head provide a wide range of recording times. At the slow speed of 3.75 inches per second, a 7 inch (1200 ft.) reel records continuously for one hour, or a total of two hours by recording on the second half of the tape width. At the fast speed of 7.5 inches per second, these recording times are one-half hour continuously and one hour over all. Frequency response is flat from 70 to 8,500 cps at 7.5 inch speed and 90 to 6,000 cps at the 3.75 inch speed.

It is supplied complete with crystal microphone and 8 foot microphone cable, 600 foot reel of type "A" tape, 5 inch take-up reel, and all tubes. For operation from 105–120 volts, 60 cps ac.

Stock number is 96–485, and the cost is $99.50, net f.o.b. Chicago.

Instrument Resistor

Type 245S, a new 1-watt precision wire-wound resistor for decades and other applications requiring low resistance values with close tolerances, low temperature rise, and low inductance, has been announced by the **Shallcross Manufacturing Co.**, Collingdale, Pa. The new resistor can be calibrated to a tolerance of ±0.1 per cent or better and is available in values from 0.1 ohm to 1,000 ohms. A single layer bifilar winding protected by a moisture resistant lacquer coating is used for all values. The Steatite bobbin and axial wire leads at the same end make it easy to mount the resistor directly on decade switch decks or other similar equipment. Size is 1⅛ inches long by ⅜ inch diameter.

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

Electrostatic C-R Tube Testing Console

Development of a new console unit for testing electrostatic cathode-ray tubes was announced today by the **Cathode-ray Tube Div., Allen B. Du Mont Laboratories, Inc.**, 1500 Main Ave., Clifton, N.J.

The new unit, Type 2166, is intended for production testing. Type 2166 can test electrostatic tubes for breakdown and stray emission, astigmatism, spot or raster cutoff, spot examination, line width, deflection factor or sensitivity, leakages, angle between traces, deflection plate cutoff and base alignment. In essence, it can perform all electrical tests required by JAN-IA. Simultaneous displays and interaction tests of dual-beam cathode-ray tubes, such as the 5SP-, also can be made.

Type 2166 features well regulated power supplies, internally supplied sweeps and operating potentials for tube electrodes (G1, A1, A2, A3) and positioning. Rasters and screen displays remain steady with line voltage and intensity changes. Anode voltages may be preset and do not change with intensity changes. The master switch automatically determines proper anode voltages and other conditions necessary for each test, leaving a minimum of adjustments for the operator.

The unit also has a linear sweep system providing amplitudes sufficient for present-day tubes or any likely to be produced in the near future. Linearity is excellent even in critical measurements such as the merging-raster method of line measurements. Dual vertical and horizontal sweeps are provided for simultaneous displays on dual-beam tubes such as the Type 5SP-. There are separate controls for each beam including intensity, focus, positioning and amplitude and the coverage of the unit can be extended for more complex multi-beam tubes.

Alignment between traces is checked directly with a simultaneous display of vertical and horizontal traces. Vertical and horizontal plate deflection factors can be checked successfully with a single control and a single meter without additional switching. A circular trace and annular ring display is provided for tubes such as the 3DP- and can also be useful in astigmatism and other tests.

Type 2166 is housed in a metal cabinet, 60 inches wide, 75 inches high and 38 inches deep.

For detailed information, write to the Technical Sales Dept., Allen B. Dumont Laboratories, Inc. 1500 Main Ave., Clifton, N.J.

FM Modulation Monitor

Browning Laboratories, Inc., 750 Main St., Winchester, Mass., announces the MD-33 Frequency Modulation Monitor designed to check the modulation swing of FM transmitters operating in the Police, Fire and Special Service bands from 25 to 174 mc. This continuous coverage is accomplished in two bands without the use of plug-in units of any kind.

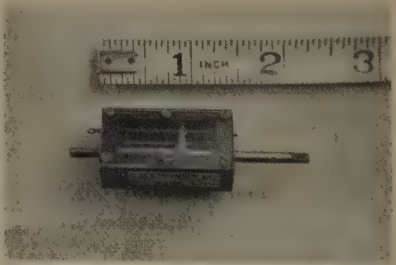
Modulation swing is indicated directly on a four inch panel meter with a 20 kc full scale linear calibration. A dual range flasher circuit permits checking overmodulation by the shortest of voice peaks at either of two pre-set amounts of swing.

Dimensions: Height 9 inches, Width 20½ inches, Depth 12 inches. Weight is 35 lbs.

Full details are available upon request.

Potentiometers

A new line of precision potentiometers is now being manufactured by **Galetronics, Inc.**, Pasadena, Calif. Their object is to manufacture precision potentiometers for telemetering and electronics industries, specializing in sub-miniature types such as shown here. Rotary Type RC can be furnished up to 320,000 ohms with a resolution of 0.1 per cent, in a ¾ inch diameter case. Type LE (illustrated), a rectilinear potentiometer, in a case 1⅜ inch long, can be furnished up to 1,000,000 ohms with a resolution of 0.05 per cent.



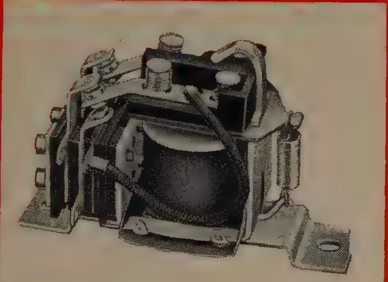
Galetronics places particular emphasis on custom-engineering potentiometers to the user's specifications and have a complete staff for this purpose. Address inquiries to Galetronics, Inc., c/o Eastman-Pacific Co., 2320 E. 8th St., Los Angeles 21, Calif. Eastman-Pacific has been appointed sales representative.

(Continued on page 50A)

SCRAMBLING MESSAGES TO GUIDED MISSILES

or SEPARATING METALS

Relays BY GUARDIAN



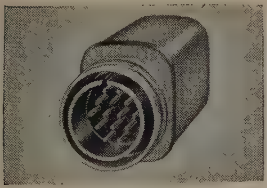
SERIES 155-A RELAY

The Series 155-A Relay is compact, sturdy, easily mounted, small in size. Constant spring tension contacts attached to armature "make" before armature completes its travel, balance of travel being taken up by the spring. A firm, wiping contact compensates for misadjustments or voltage variations. Fixed contacts mounted on field piece. Moulded bakelite armature insulator. Operates up to 220 volts.

COVER A WIDE RANGE OF CONTROL APPLICATIONS . . .

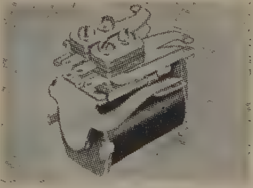
One of many methods used for the operation and control of guided missiles is multiple channel transmission that scrambles the channels and frequencies on which the control signal is sent. A Guardian *hermetically sealed* unit, specially designed for continuous switching of multiple channel transmission, is used to prevent interception of the missile by unfriendly hands.

Another application of Guardian units—the Series 155-A Relay regulates the duty cycle of a Thyratron tube to control the time involved operating a testing tool for the separation of metals. This sorting principle employs the tribo-electric effect on metals, steel and non-ferrous alloys, whereby a standard metallic specimen held in the chuck of a reciprocating tool is rubbed against the unknown for a controlled time. Should a chemical or metallurgical dissimilarity exist between the chuck-held specimen and the unknown material, a minute electrical current is generated and so indicates on a calibrated dial. Thus, the operator quickly identifies, sorts and accomplishes non-destructive testing of each metal item. There's a Guardian unit to solve your control problem. Write.

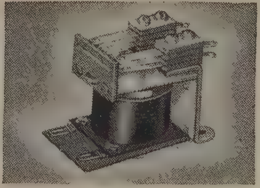


AN-3303-1 D.C.

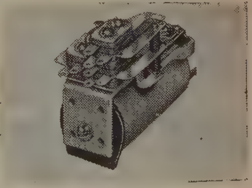
AN-3324-1 D.C.



Series 595 D.C.



Series 610 A.C.—615 D.C.



Series 695 D.C.

WRITE—WIRE—TELETYPE—PHONE NOW!

GUARDIAN ELECTRIC

1628-A W. WALNUT STREET
CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

FUNCTION-FITTED to any clime...

Climatic extremes call for *function-fitted** capacitors.

Because Aerovox engineers have all climates at their finger tips, thanks to lab equipment second to none, they know precisely the meaning of sub-sub-zero temperatures . . . flying at 75,000 feet . . . elevated temperatures above the melting point of solder . . . extreme humidity . . . fungus problems.

That is why Aerovox capacitors are so popular *in all climes.*

*Aerovox capacitors can be fitted to your circuitry, associated components and operational requirements, often at substantial savings, always for better performance, and never at added cost. Let us tell you about it.

FUNCTION FITTED

AEROVOX CAPACITORS

AEROVOX CORPORATION
NEW BEDFORD, MASS.

HI-Q® DIVISION
OLEAN, N. Y.

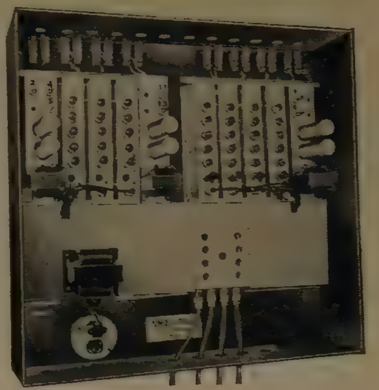
WILKOR DIVISION
CLEVELAND, OHIO

Export: 41 E. 42nd St., New York 17, N. Y. • Cable: AEROCAP, N. Y.
• In Canada: AEROVOX CANADA LTD., Hamilton, Ont. JOBBER ADDRESS: 740 Belleville Ave., New Bedford, Mass.

News—New Products

(Continued from page 22A)

Amplified TV Antenna System



A new master-amplified TV antenna system is now available to owners of apartment buildings, hotels, institutions, and TV service organizations. It is made by **Amplitel, Inc.,** 362 W. 57 St., New York 19, N. Y. Amplitel is a custom-engineered system, as differentiated from booster type equipment, and offers these functional advantages.

It is an amplified system designed to produce peak reception on each channel in an area on every TV set in a building regardless of location. There is no interference between sets, and no cross-modulation between channels. By the use of one specially designed yagi-type antenna for each channel; stronger directional signals are obtained free of multipath reflection, even in ghosty or weak signal areas.

By amplifying each channel separately, weak signals are amplified in weak areas, and strong signals are balanced, so that all channels are received at the same level at the receiver. All signals are automatically mixed to the required number of risers, AM, FM, or both are available. One Amplifier is capable of servicing as many as 175 sets. It is easy to install and service, and is adaptable to color and uhf.

High Fidelity Amplifier

Recently introduced by **Precision Electronics,** 9101 King Ave., Franklin Park, Ill., is their model 100 BA, designed as a basic amplifier for the average high fidelity home system. Features include full range reproduction with low distortion together with tonal purity. Power outputs: 10 watts; 20 watts peak. Distortion at 10 watts, 1 per cent harmonic and 2 per cent intermodulation. Frequency response at 3 watts ±0.5 db, 20 to 50,000 cps. Frequency response at 10 watts ±1 db, 30 to 20,000 cps.

Complete information may be obtained from the manufacturer.

New Brochure

A new brochure featuring "Unitized Construction" and standardization of precision potentiometers is available from **Servotrol Co.,** 114 W. Illinois St., Chicago 10, Ill. Requests should be directed to the Servotrol Co., Eastern Branch Office, Framingham Centre, Mass.

(Continued on page 51A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 50A)

Stepping Switch

Bi-directional stepping switch (Model 27000), adaptable to a wide variety of applications usually impracticable for conventional switches, has been developed by **Consolidated Engineering Corp.,** 300 N. Sierra Madre Villa, Pasadena 8, Calif. It is capable of advancing or reversing with equal ease and speed. Self interrupted, completely reversible operation makes possible its use in many types of high-speed, differential counter and servo-mechanism designs. In addition to its direct use as a bi-directional switch in circuits requiring contact closures, Model 27000 is also quickly convertible to a stepping motor for special servo and control applications because its output shaft is free at both ends for connections to many types of external attachments.

As a differential counter, the unit is used to indicate a remaining quantity or balance on hand. As a remote positioning motor, the switch mechanism can be controlled by bi-directional, remote sources. In automatic computers, it can be used as a digit-storage register. As an automatic attenuator, it is used to add or subtract resistances for adjusting gain and preventing overloads. And as a digital, self-balancing bridge, Model 27000, together with discrete resistance steps, converts analog test or process data directly to digital contact closures immediately available for computation or control.

The switch mechanism, an electro magnetically operated pawl and ratchet, steps the output shaft to 36 discrete angular positions in 10° steps. Drive is direct, since shaft movement occurs upon energization of the coil rather than through the use of springs. A typical switch has four parallel circuits to 12 positions. Special contact banks with up to 25 contact positions can be furnished, however, by replacing a level of contacts with a solid metal sector to provide center feed to the wipers, full 360° rotation is obtained over 36 contacts. Write for Bulletin 3004.

Germanium Diodes

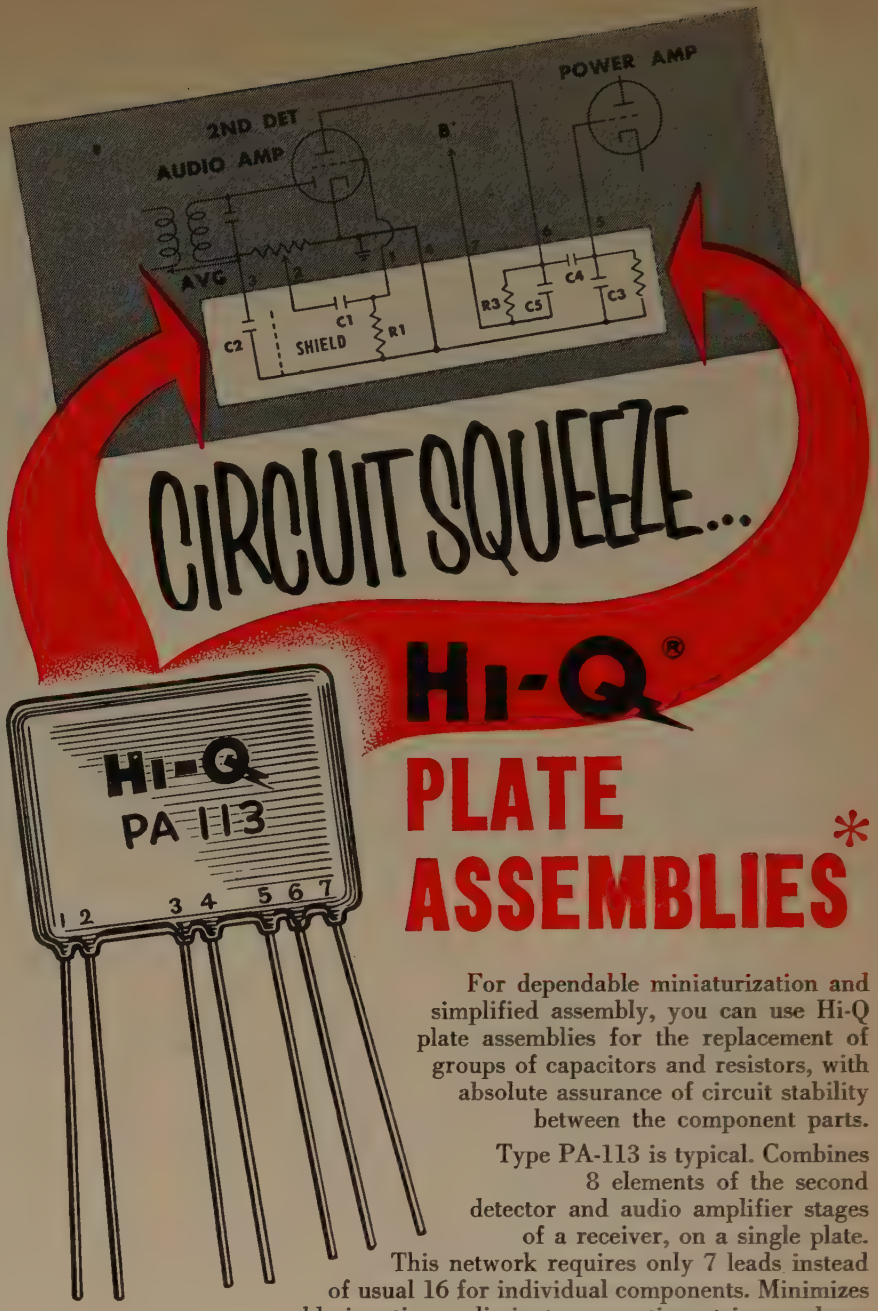
Amperex Electronic Corp., 230 Duffy Ave., Hicksville, L. I., N. Y., announces the addition of a line of 7 germanium diodes of hermetically sealed glass variety which are not affected by atmospheric conditions of humidity, altitude and extremely low temperature.

Four of these diodes are electrically interchangeable with well-known standard types, and the others are new. All of them are highly resistant to shock and vibration.

The types IN34A, IN38A, IN54A, IN58A, IN86, IN87 and IN88 are presently listed. In addition, a number of new diodes, now in development, will follow for which there are presently no interchangeable types on the market.

Complete technical data is available on request from Amperex.

(Continued on page 96A)



Hi-Q®

PLATE ASSEMBLIES*

For dependable miniaturization and simplified assembly, you can use Hi-Q plate assemblies for the replacement of groups of capacitors and resistors, with absolute assurance of circuit stability between the component parts.

Type PA-113 is typical. Combines 8 elements of the second detector and audio amplifier stages of a receiver, on a single plate. This network requires only 7 leads instead of usual 16 for individual components. Minimizes soldering time; eliminates mounting strips; reduces stocking and handling problems.

Other Hi-Q plate assemblies provide vertical integrator, vertical integrator and coupler, audio plate grid coupler, pentode second detector and audio amplifier, pentode plate coupler and screen supply, etc.

***FUNCTION-FITTED TO YOUR NEEDS**

Regardless what your "circuit squeeze" problems may be, Hi-Q specialists can provide the ideal solution in either standard or special types. Send us those problems!

FUNCTION FITTED

Hi-Q® DIVISION

AEROVOX CORPORATION

OLEAN, NEW YORK

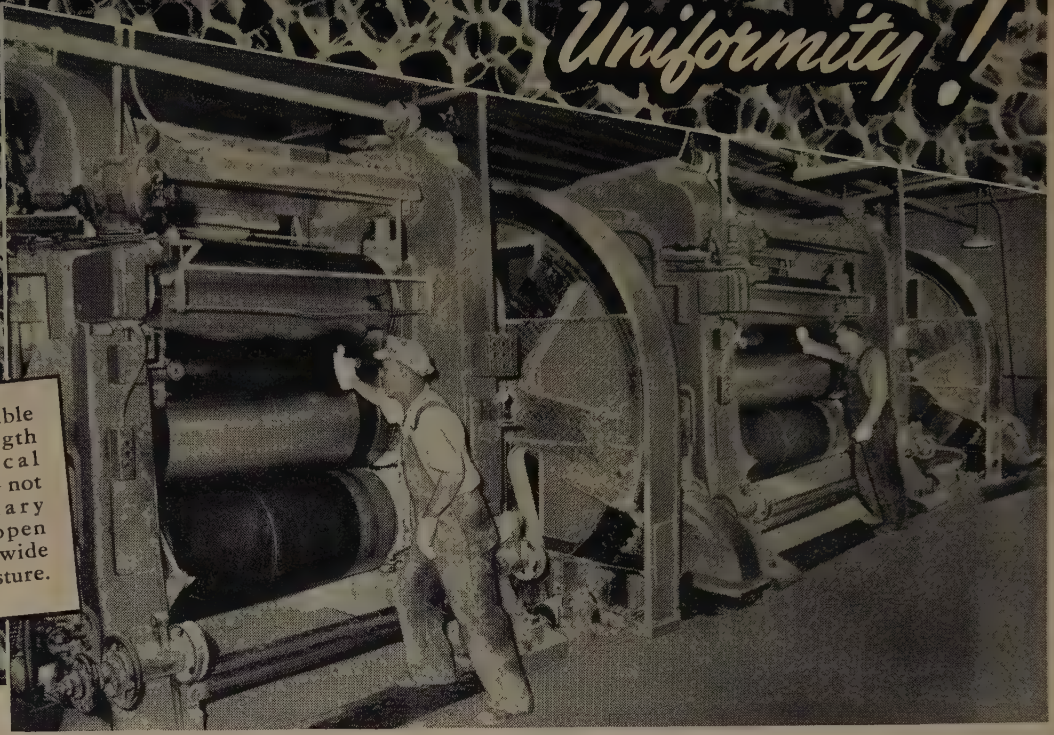
AEROVOX CORPORATION
NEW BEDFORD MASS.

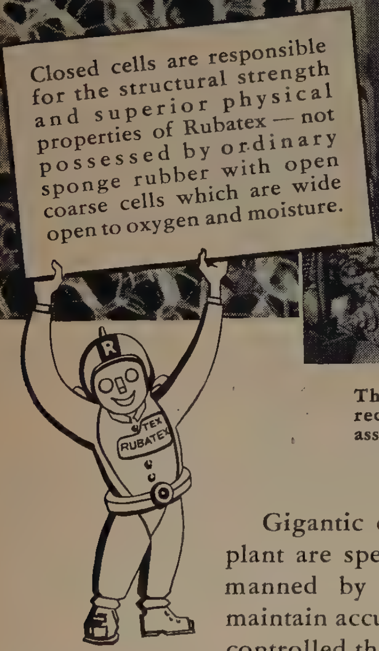
WILKOR DIVISION
CLEVELAND, OHIO

Export: 41 E. 42nd St., New York 17, N. Y. • Cable: AEROCAP, N. Y.
In Canada: AEROVOX CANADA LTD., Hamilton, Ont. JOBBER ADDRESS: 740 Belleville Ave., New Bedford, Mass.

RUBATEX *is Calendered for Uniformity!*

MEETS A. S. T. M. TOLERANCES





Closed cells are responsible for the structural strength and superior physical properties of Rubatex — not possessed by ordinary sponge rubber with open coarse cells which are wide open to oxygen and moisture.

The calender sheets out raw stock to required thickness prior to curing... assuring controlled thickness of Rubatex.

Gigantic calender rolls at the Rubatex plant are specially designed and skillfully manned by experienced operators who maintain accurate adjustments . . . to assure controlled thickness of RUBATEX to meet ASTM tolerances for cellular rubber . . . to smooth the way for better product performance in gasketing, sealing, shock absorption, sound deadening, and vibration isolation applications. A plus feature of controlled thickness is the fact that RUBATEX gaskets can be tightened down to a good seal with very little danger of breaking plastic or glass parts.

In addition, RUBATEX offers greater cushioning and resiliency than other soft rubber materials . . : is soft, pliable, and easy to work with . . . is rot and vermin proof.

You can always depend on the uniformity of RUBATEX both in superior physical properties and excellency of performance. Next time — try RUBATEX!

RUBATEX AT WORK . . .

AUTOMOTIVE & AIRCRAFT

- Arm rests
- Battery supports
- Lamp gaskets
- Heater core gaskets
- Cowl gaskets
- Window gaskets
- Fuel cell cushions
- Floor mats
- Anti-squeak pads

CONSTRUCTION

- Expansion joint seals
- Weather stripping

INDUSTRIAL

- Instrument gaskets
- Fatigue mats
- Low temperature insulation
- Dust-proof seals
- Moisture-proof seals
- Gasketing
- Vibration isolation
- Shock absorption

PACKAGING — Packing cushion for fragile goods and delicate scientific instruments.

REFRIGERATION — Gasketing for refrigerator and cold storage room doors.

SPORTING GOODS — "Air cushioning" padding for athletic equipment and apparel.

CONSUMER & HOUSEHOLD PRODUCTS

- Shoe innersoles
- Hearing aid "cushioning"
- Appliance gaskets
- Bath and kitchen mats

Send us details of your proposed applications and let us send you samples and recommendations.
Write Dept IRE-1, Great American Industries, Inc., Rubatex Division, Bedford, Virginia.

FOR AIR THAT PROTECTS — USE RUBATEX

RUBATEX CLOSED CELLULAR RUBBER

PIONEER MANUFACTURER OF CLOSED CELLULAR RUBBER
R
TEX
RUBATEX
©

Whenever circuits call for precision and high resolution in compact space...

There's a 10-turn Helipot to meet your requirements

With the development of the original HELIPOT—the *first* multi-turn potentiometer—an entirely new principle of potentiometer design was introduced to the electronic industry. It made possible variable resistors combining high resolution and high precision in panel space no greater than that required for conventional single-turn potentiometers.

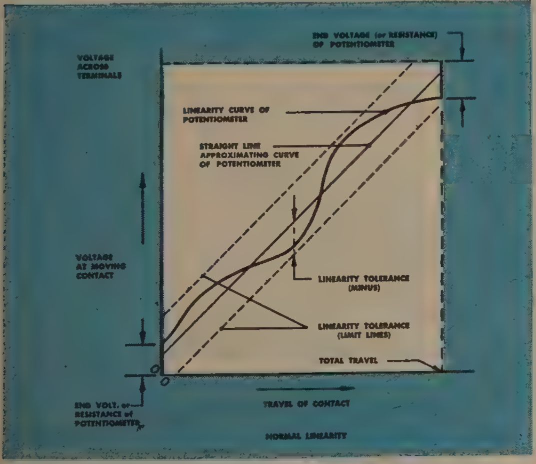
The Helipot Principle... *High resolution and precision settings require a long slide wire. But by coiling a resistance element into a helix, it is possible to gain desired resolution and precision without wasting panel space. This principle is applied in various Helipot models with slide wires ranging from 3 to 40 helical turns.*

Advantages are immediately apparent. In the case of the widely-used 10-turn Model A Helipot, for example, a 45″ long slide wire—coiled into ten helical turns—is fitted into a case 1¾″ in diameter, and 2″ in length. Another advantage of the 10-turn pot is that, when equipped with a turns-indicating RA Precision DUODIAL, slider position can be read directly as a decimal, or percentage, of total coil length traversed.

10-TURN HELIPOT MODELS—CONDENSED SPECIFICATIONS

	Model A	Model AN	Model AJ
No. of turns	10	10	10
Resistance Range	10 ohms to 300,000 ohms	100 ohms to 250,000 ohms	100 ohms to 50,000 ohms
Resistance Tolerance:			
Standard	±5%	±5%	±5%
Best	±1%	±1%	±3%
*Linearity Tolerance:			
Standard	±0.5%	±0.5%	±0.5%
Best	±0.05% (1K ohms and above)	±0.025% (5K ohms and above)	±0.1% (above 5K ohms)
Power rating @ 40°C	5 watts	5 watts	2 watts
Mechanical Rotation	3600° +4° −0°	3600° +1° −0°	3600° +12° −0°
Electrical Rotation	3600° +4° −0°	3600° +1° −0°	3600° +12° −0°
Starting Torque	2 oz. in.	1.0±.3 oz. in.	.75 oz. in.
Running Torque	1.5 oz. in.	0.6±.3 oz. in.	.60 oz. in.
Net Weight	4 oz.	4 oz.	1 oz.

*i.e. INDEPENDENT LINEARITY. The above linearity tolerances are based on the following definition recently proposed to clarify and standardize nomenclature related to precision variable resistors. . . . "Independent linearity is the maximum deviation in percent of the total electrical output of the actual electrical output at any point from the best straight line drawn through the output versus rotation curve. (This line shall be measured through the extent of the effective electrical angle.) The slope and position of the straight line from which the linearity deviations are measured must be so adjusted as to minimize these deviations."


END VOLTAGE (or RESISTANCE) OF POTENTIOMETER
VOLTAGE ACROSS TERMINALS
LINEARITY CURVE OF POTENTIOMETER
STRAIGHT LINE APPROXIMATING CURVE OF POTENTIOMETER
VOLTAGE AT MOVING CONTACT
LINEARITY TOLERANCE (MINUS)
LINEARITY TOLERANCE (LIMIT LINES)
TOTAL TRAVEL
0
0
END VOLT. or RESISTANCE of POTENTIOMETER
TRAVEL OF CONTACT
NORMAL LINEARITY

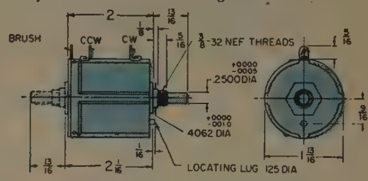
10-Turn Helipot Highlights

From the basic Helipot principle, model variations have been developed to meet new requirements:

Model A Helipot

the original 10-turn Helipot—provides a resolution from 12 to 14 times that of conventional single-turn potentiometers of same diameter (1¾″), linearities as close as ±0.05% in resistances as low as 1K ohms.

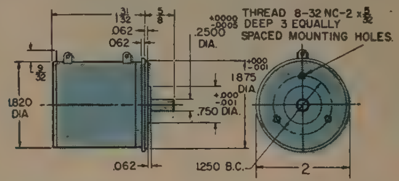
The same multi-turn principle is also available in 3 turn units (Model C), and larger-diameter units of 15 turns (Model B), 25 turns (Model D), and 40 turns (Model E)—a type for every application from 5 ohms to 1 megohm.

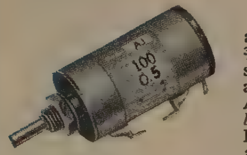


Model AN Helipot

an ultra-precision version of the basic 10-turn Helipot. Produced in volume to extremely close electrical and mechanical tolerances, this unit features precision ball bearings (Class 5), servo mounting lid, plus linearity tolerance as close as ±0.025% as low as 5K. A 3-turn unit (Model CN) is also available.

Models AN and CN are particularly recommended for precise servo-mechanism applications and represent the most advanced design and highest quality available today in the field of precision potentiometers.

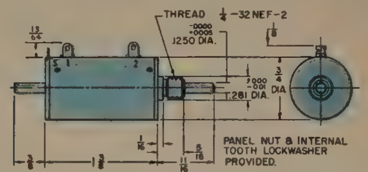

THREAD 8-32 NC-2 × 3/16 DEEP 3 EQUALLY SPACED MOUNTING HOLES.
.2500 DIA.
.062
1.820 DIA
.1875 DIA
.750 DIA.
1250 B.C.
2



Model AJ Helipot

a 10-turn *miniature* Helipot only ¾″ in diameter, weighs 1 oz., has slide wire 18″ long. Also available with servo mounting (Model AJS) and servo mounting with *ball* bearings (Model AJSP). Linearities as close as ±0.1% as low as 5K.

Designed for long life under severe operating conditions, the AJ Series is widely used where small size and weight are vital.



Design details on above units are subject to change without notice. Certified drawings available upon request.

Only Helipot is able to supply—in volume—multi-turn helical potentiometers *with special features to meet your particular needs* . . . Special Shafts, Extra Spot Welded Taps at any position, Ganged Assemblies (except AJ), Special Temperature Coefficients, etc. Send us your requirements!

For complete details contact your nearby Helipot representative. Or write direct.

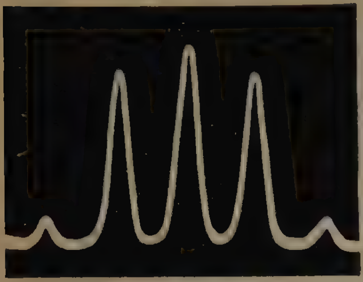
THE Helipot CORPORATION
A subsidiary of Beckman Instruments, Inc.
SOUTH PASADENA 6, CALIFORNIA

Field Offices: Boston, New York, Philadelphia, Rochester, Schenectady, Cleveland, Detroit, Chicago, St. Louis, Los Angeles, Seattle, Dallas, High Point, N. C. and Fort Myers, Florida. In Canada: J. S. Root, Toronto. Export Agents: Frathom Co., New York 36, New York.

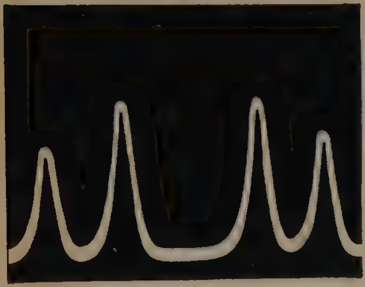
Unmodulated Carrier

MEASURE FM

THE SPEEDY WAY



Modulation Index 1.3



Modulation Index 2.4
The Carrier "Disappears"

FM DEVIATION METER
TF934

For carriers in the range 2.5 to 200 megacycles, this ruggedized deviation meter is ideal. With crystal-standardized deviation ranges of 5, 25 and 75 kilocycles, alternative high- and low-level buffered inlets, visual checking for optimum tuning and level, together with a separately buffered audio outlet, FM Deviation Meter TF 934 incorporates every desirable refinement. There are no critical tuned circuits to drift and the overall demodulation distortion is less than 0.1 per cent.

MARCONI INSTRUMENTS

Specialists in Communication Test Equipment

23-25 BEAVER STREET · NEW YORK 4

CANADA: CANADIAN MARCONI CO., MARCONI BUILDING, 2442 TRENTON AVENUE, MONTREAL
ENGLAND: Head Office: MARCONI INSTRUMENTS LIMITED · ST. ALBANS · HERTS.
Managing Agents in Export: MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED
MARCONI HOUSE, STRAND · LONDON · W·C·2

Industrial Engineering Notes[1]

EDUCATIONAL BROCHURE PUBLISHED BY RTMA

An educational brochure aimed at acquainting equipment manufacturers, their design engineers, the military and electronic jobbers with problems created by the selection of "close-limit" tubes has been distributed by RTMA. The four-color, illustrated brochure was published on the recommendation of the RTMA Tube Division under the chairmanship of R. E. Carlson.

The theme of the brochure is that if a tube must be specially selected, the tube manufacturer, himself, is best qualified to make the selection and to provide the appropriate tube designation.

The proper solution of the problem, according to the brochure, is in the original design of all equipment. The equipment should function with tubes having characteristics which fall anywhere in the entire range covered by the tube specifications. Salient points of this solution for equipment manufacturers are: (1) Your designers should work with tube makers in earliest stages. RTMA members will be glad to furnish type samples and their recommendations for your needs. (2) Explore all possibilities with tube makers' engineers before equipment designs are finalized and production begins. This will prevent serious difficulties later. (3) When it is determined that standard tubes will not give satisfactory performance, discuss the problem with the tube manufacturer. There are two courses of action to solve the problem, either the circuit has to be modified or a new tube type has to be considered—*avoid selections.*

A limited number of copies of the brochure are available through RTMA headquarters.

SPEAKMAN RESIGNS FROM RDB

E. A. Speakman, vice chairman of the Research and Development Board, resigned November 1, 1952, to become general manager of the guided missiles division of Fairchild Engine and Airplane Corporation, Wyandanch, L.I., N.Y. He became vice chairman of the Board in May, 1949, and previously had been connected with its Committee on Electronics.

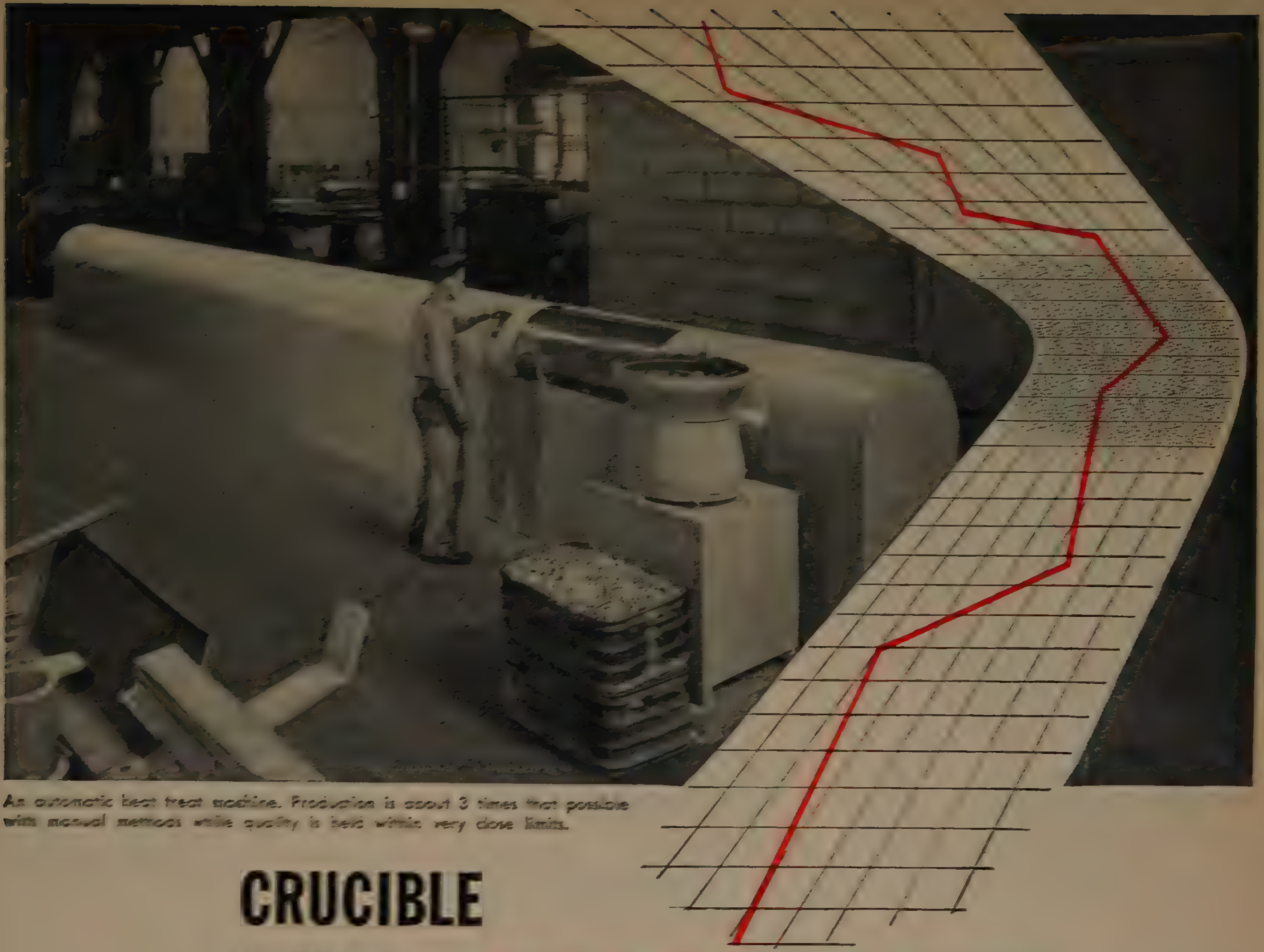
JETEC CONFERENCE SCHEDULED

The second JETEC General Conference is scheduled to be held at Haddon Hall, Atlantic City, N.J., on March 19–21, 1953, according to Virgil M. Graham, chairman of the Joint Electron Tube Engineering Council.

(*Continued on page [illegible]*)

---

[1] The data on which these NOTES are based were selected by permission from *Industry Reports*, issues of October 31, November 7, November 14, and November 24, 1952, published by the Radio-Television Manufacturers Association whose helpfulness is gratefully acknowledged.



An automatic heat treat machine. Production is about 3 times that possible with manual methods while quality is held within very close limits.

CRUCIBLE
ALNICO
MAGNETS

KEEP COSTS DOWN *. . . through automatic production that gives quality control*

Alnico magnets have been getting smaller and lighter, thanks to production techniques in use at Crucible. Automatic machinery cuts the possibility of human error to a minimum, so rejections are low. This helps to maintain stable price levels in the face of rising material and labor costs. At the same time, Crucible's rigid inspection standards and attention to quality have developed a magnet with the *highest gap flux per unit weight of any on the market.*

Today, Crucible can offer lighter, magnetically stronger Alnico magnets because of these automatic production techniques developed over the sixteen years that we have been producing the Alnico alloys. And behind our familiarity with permanent magnets lies more than 52 years' experience with specialty steelmaking. Let us advise you on your magnet problem.

CRUCIBLE first name in special purpose steels

52 years of Fine steelmaking

PERMANENT ALNICO MAGNETS

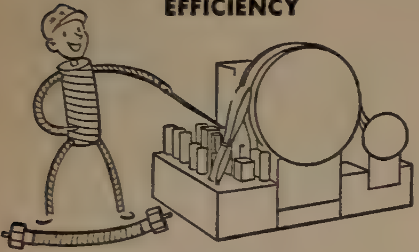
CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH 30, PA.
STAINLESS • REX HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

A TIP FROM CHIEF ENGINEER FLEXY:—

S.S.WHITE FLEXIBLE SHAFTS CAN HELP YOU IMPROVE DESIGNS AND LOWER COSTS

Most electronic equipment contains parts and circuit elements which require adjustment or control from remote points. Whether the distance involved is a few inches or 50 feet or more, S.S.White flexible shafts should be considered as a means of providing the desired control. Here are four reasons why—

IMPROVED CIRCUIT EFFICIENCY



S.S.White flexible shafts give you all the freedom you need in locating controlled elements wherever desired to satisfy space, wiring, servicing and circuit requirements. They'll bring control to any point you need it.

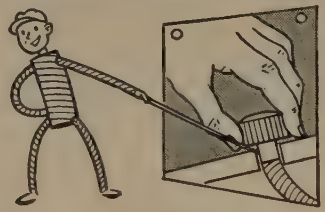
BETTER CONTROL PANEL ARRANGEMENTS

S.S.White flexible shafts simplify the job of getting a desirable grouping of the control knobs on the cabinet or instrument panel. They'll allow you to place the control knobs anywhere regardless of how the circuit elements are arranged.

FASTER ASSEMBLY

S.S.White flexible shafts are supplied in any desired length ready for installation. A simple coupling to the control knob and another to the variable element is all you need. No alignment, extra parts, or special assembly skill is required.

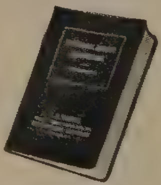
LIFELONG SENSITIVITY



S.S.White remote control flexible shafts are especially designed for this service. Tuning with them can be as smooth as a direct connection. What's more, they won't slip, wear out or lose their sensitivity. They're good for the life of the equipment.

Send For the 256-Page Flexible Shaft Handbook

It has full authoritative information and data on flexible shaft construction, selection and application. Copy sent free if you request it on your business letterhead and mention your position.



THE S.S.White DENTAL MFG. CO. INDUSTRIAL DIVISION

Dept. G, 10 East 40th St.
NEW YORK 16, N. Y.

Western District Office · Times Building, Long Beach, California

Industrial Engineering Notes

(*Continued from page 66A*)

Industry Statistics

The September, 1952 report showed an estimated total of 640,793 TV set-type tubes sold to equipment manufacturers and total sales of 788,107 units sold for renewal, to the government, for export and to equipment manufacturers. . . . Members of the sales managers committee, under chairman J. F. Walsh, who met during the RTMA Industry Conference in Chicago, conducted an **informal poll on the expectations of television set production by the industry in 1953.** The average of these "guess estimates" was 6.4 million compared with an earlier estimate of 5.7 million obtained in a similar poll previously. Individual guesses ranged from 517 million to 8 million sets at the Chicago meeting. . . . The **production of television receivers in October, 1952 was 75 per cent above the same month of 1951,** according to RTMA estimates. The radio output, however, declined from the level of last year. The RTMA report for October, 1952 showed the production of 724,117 TV sets and 772,346 radios compared to 411,867 television sets and 874,723 radio receivers in the same 1951 month. During the first 10 months of 1952, the RTMA report showed the production of 4,394,708 TV sets and 7,461,881 radios.

FCC Actions

The FCC moved to permit **the use of 448 kc by ship station licensees presently authorized to use telegraph frequencies below 535 kc.** The Commission issued an order, effective November 1, 1952, that all ship telegraph licenses presently authorized to use frequencies below 535 kc are permitted to use the working frequency 448 kc (Region 2 only, emission 0.166 A1 or 2.66 A2) until November 1, 1953, or until the date of expiration of the present license for each ship station, whichever is earlier. . . . The FCC moved to **amend its Rules and Regulations Governing Aeronautical Services to bring them into conformity with the agreement reached at the Extraordinary Administrative Radio Conference (EARC),** Geneva, 1951. The FCC change was contained in Mimeo 52-1421, which is available from the Commission's Information Office. . . . The Commission has issued a **Report and Order stemming from its earlier rule making proceedings to amend Part 8 of the rules covering the assignment of frequencies to ship stations.** The order, which changes a large number of ship frequencies effective January 1, 1953, is available from the FCC (Mimeo No. 82,579). . . . The Commission issued another **Notice of Proposed Rule Making, November 19, 1952, looking toward further amending Part 8 of the maritime rules to bring into force, as of June 3, 1953, the new ship radio telegraph frequencies from 22,000 to 22,400 kc.** The action was taken to

(*Continued on page 71A*)

Industrial Engineering Notes

(Continued from page 68A)

further implement the International Radio Regulations (Atlantic City, 1947) and is in accordance with the Extraordinary Administrative Radio Conference (Geneva, 1951) agreement.

RESEARCH NEWS

An electronic pulse generator which can provide nearly square-topped pulses at voltages up to 1,200 volts and currents up to several amperes has been developed by the National Bureau of Standards. The device was developed by the Bureau's Electronic Instrumentations Laboratory to supply the heavy pulses required in an earlier NBS study of vacuum-tube cathode emissions. It is expected, however, to find other applications where nearly square-topped pulses are required at high voltages and heavy currents. The pulse frequency is variable in steps of 10, between 10 and 60 pulses per second. Pulse duration, a constant one per cent of the period at each frequency, ranges from 165 microseconds at 60 cycles to 1,000 microseconds at 10 cycles. Complete details on the pulse generator appears in the December issue of the NBS "Technical News Bulletin." . . . **An eight-page technical report on "Physical Limitations to Directional Antenna Systems in the Standard Broadcast Band"** now is available through the Federal Communications Commission. It is a theoretical study, checked by measurements, of the variations in radiated field intensity about the theoretical pattern factor. The report. T.R.R.1.2.6., is available on request to the Technical Research Division, Office of Chief Engineer, Federal Communications Commission, Room 1614, Temporary T Building, Washington 25, D. C.

FTC HEARING SET FOR 1953

H. Paul Butz, of the Bureau of Industry Cooperation, Federal Trade Commission, advised RTMA in December, 1952, that a public hearing on rules for the radio and television industry will not be held until after the first of the year. Mr. Butz cited the Christmas season saying that he felt that a hearing during December would work a hardship on dealers and manufacturers.

NEW STANDARD ISSUED

The Underwriter's Laboratories, Inc., has issued a new "Standard for Power-Operated Radio Receiving Appliances." The October, 1952 standards represent the eighth edition and supersede the edition of February, 1950.

NPA OFFICIAL SAYS INDUSTRY NOT OVERLOADED

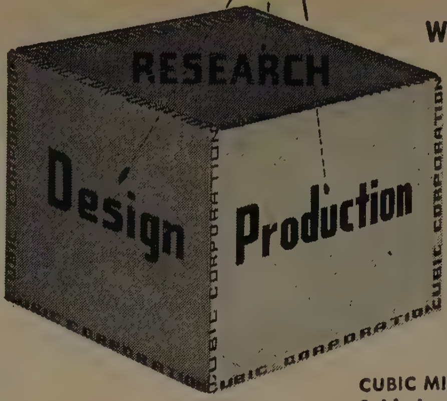
While current production of the electronics industry is at an annual going rate in excess of $4 billion, the industry is

(Continued on page 72A)

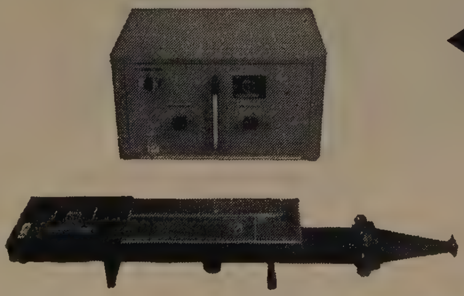
CUBIC'S 3 SIDED COVERAGE

PROVIDES YOU WITH THE WORLD'S FINEST PRECISION

- MICROWAVE & RADAR COMPONENTS
- ELECTRONIC INSTRUMENTS & TEST EQUIPMENT



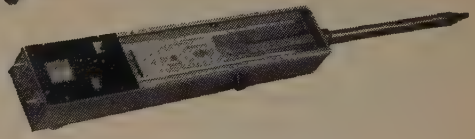
CUBIC MICROWAVE ENGINEERS—specialists in the field since the inception of Radar in World War II—start with electronic problems and ideas, and convert them into the most accurate precision-built electronic instruments and equipment! We welcome inquiries—not only in connection with our rapidly developing list of products—as represented below—but on ideas, problems, or design of microwave assemblies of your own specification you may want developed and produced.



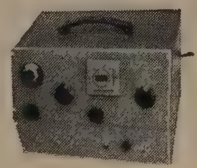
MICROWAVE CALORIMETRIC WATTMETER

portable . . . for lab and field use . . . to measure absolute microwave power.
Frequency Range: 2600 MC to 26500 MC
Max. VSWR: 1.1
Max. Peak Power: 600 KW

COAXIAL CALORIMETRIC WATTMETER



Frequency Range: 200 MC to 3000 MC—Max. VSWR: 1.5 over range—Max. Peak Power: 1⅝" Coaxial rating

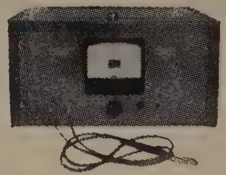


MICROWAVE (X-BAND) PULSE MEASURING WATTMETER

for measuring peak power of microwave pulses from signal generators or radar systems.

ELECTRONIC DIRECT-READING PHASE METER

Frequency Range: 20 to 50,000 cycles
0-360 degrees



Shown at left are a few of our standard microwave components available as catalog items. Special purpose wave guide assemblies designed to customer's specs can also be produced.

CUBIC CORPORATION
SCOTT & CANON STS.
SAN DIEGO 6
CALIFORNIA
Devoted Exclusively to Electronics & Electronic Equipment

4 NEW Potter FREQUENCY-TIME COUNTERS... Automatically READS FREQUENCY, TIME INTERVAL AND PERIOD

NEW
COMPACT DESIGN
CIRCUITS
FEATURES
LOWER PRICES

USE THEM FOR

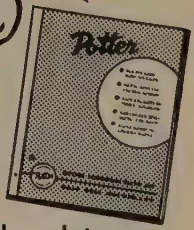
FREQUENCY MEASUREMENTS
•
PERIOD MEASUREMENTS
•
TIME INTERVAL MEASUREMENTS
•
FREQUENCY RATIO MEASUREMENTS
•
SECONDARY FREQUENCY STANDARD
•
TOTALIZING COUNTER
•
DIRECT RPM TACHOMETER

Every known need in frequency and pulse measurement is now satisfied by four completely new designs of Potter frequency-time counting equipment.

The simplified Potter 100 KC Frequency, Models 820 and 830, are suitable for rapid and precise production line applications. The versatile Potter 100 KC and 1 MC Frequency-Time Counters, Models 840 and 850, include all gating, switching, timing and counting circuitry required for any conceivable counting-type measurement.

All models feature the convenience of smaller size, lighter weight, and functional panel layout. And, optional readout indication—either the dependable Potter 1-2-4-8 decimal readout or the conventional 0-9 lamp panels—is available.

Tells All about Frequency-Time Counters—both laboratory and industrial applications.



For further data or engineering assistance write Dept. 1-E.

Potter
POTTER INSTRUMENT COMPANY, INC.
115 CUTTER MILL ROAD
GREAT NECK, N. Y.

Industrial Engineering Notes

(Continued from page 71A)

by no means overloaded with military orders, chairman R. W. Cotton, of the NPA Electronics Production Board, told the Armed Forces Communications Association. Mr. Cotton spoke before the Boston Chapter of AFCA at the Charlestown Navy Yard.

After pointing out there "seems to be some feeling that the electronics industry is overloaded with military orders," Mr. Cotton said this industry can "undertake a very substantial additional amount of production," including "additional research and development."

Employment Uptrend Continues

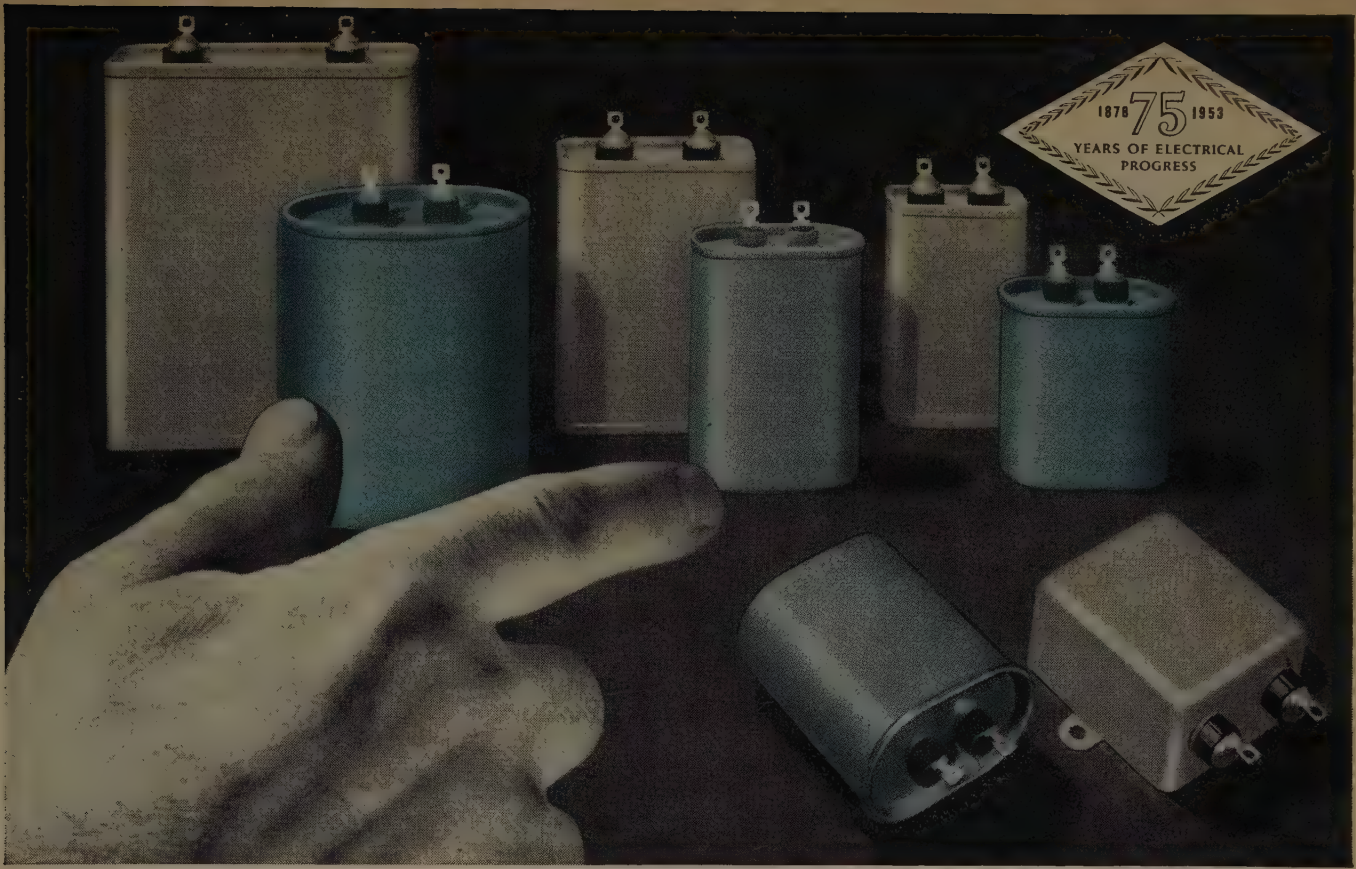
The upward trend of employment in the electronics and related manufacturing industries continued in August, 1952 and bridged the period normally characterized by a seasonal slump, according to information furnished RTMA by the United States Employment Service.

According to estimates by electronic firms, USES reports that employment will continue to increase at least until mid-February, 1953. The strong demand for TV sets and for equipment for new TV stations, as well as increasing defense requirements, were cited by USES as being responsible for the continuation of the upward trend.

Foreign News

One television station now is operating in West Berlin with a picture of 625 lines and 25 frames. The current is 50 cycles. Approximately 600 to 700 sets now are in use and sales reportedly are slow but steady due to the high costs. Two firms are producing TV receivers with a combined current capacity of 20,000 sets per year. Table models with wood cabinets comprise about 80 per cent of the sets. East Berlin also has one TV station transmitting a 625 line, 25 frame picture. The station operates only one hour per day; however, the programs all are on film, mostly of Russian origin. Set production has been announced as 200,000 sets in the next 3½ years, but it is reported that there is no visual evidence to support this claim since very few sets are in use in East Berlin. . . . **Television in Spain still is in the experimental stage,** according to reports reaching the Department of Commerce. Programming from Madrid is carried one hour daily and approximately 100 sets now are in use in that city. Other stations are contemplated in Barcelona and Bilbao. . . . **The Singapore government has announced that it is studying the cost of establishing a television station in the colony.** According to reports reaching the Department of Commerce a complete station with one or two mobile units is contemplated. A small annual license fee would be levied on set

(Continued on page 74A)



Photographic comparison of the new G-E Drawn-oval capacitors (in color) and the conventional units they replace, showing savings in size.

New General Electric Capacitor is Smaller, 10 to 20% Lower in Price

These fixed paper-dielectric hermetically-sealed capacitors offer:

- **Reduced costs—10 to 20%**
- **Savings in size and weight**
- **Double-rolled seams**
- **Drawn-steel cases**
- **Savings in critical materials**

If you're using fixed paper-dielectric capacitors with, case styles CP53 and CP70 in ratings from 1 to 10 muf, 600 to 1500 volts d-c or 330 to 660 volts a-c—these Drawn-oval units offer you improved reliability in addition to an opportunity for reducing the size, weight and *cost* of the electrical equipment you manufacture.

In the new Drawn-oval capacitors, we get minimum seam length by using drawn-steel cases, attaching the capacitor covers with a double-rolled seam of proven reliability. This construction results in a lighter, yet stronger capacitor. Actual savings in size and weight vary with case style and rating but they can amount to as much as 30%.

This new construction has enabled us to increase output while eliminating some critical materials. The resulting savings are passed on to you in the form of shorter shipments and lower prices. Prices average 10 to 20% lower than standard capacitors, again depending upon case style and, of course, quantity ordered.

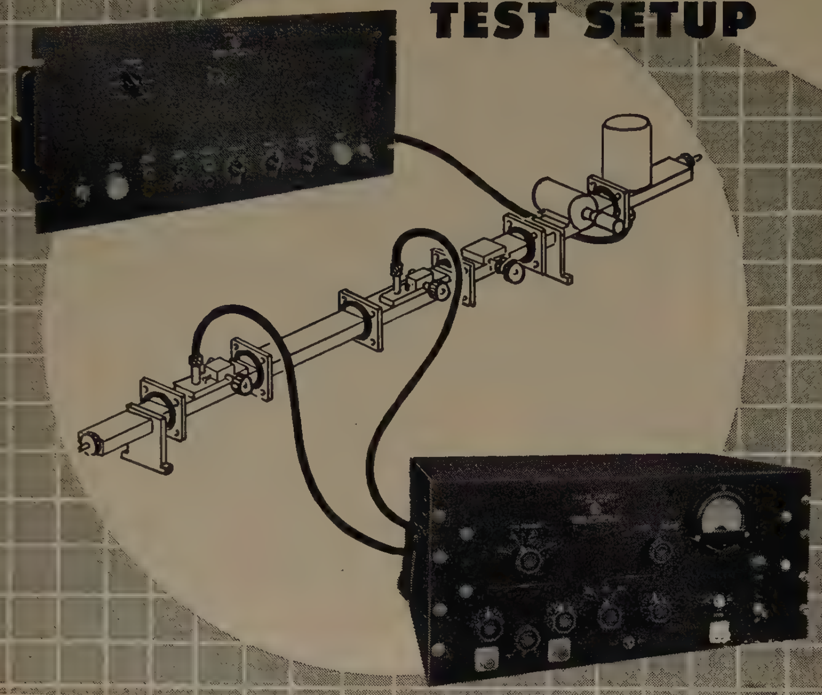
For more information on the new G-E Drawn-oval capacitors, their ratings, dimensions and prices, see your local G-E apparatus sales representative or write for Bulletin GEA-5777. Address Section 407-311, General Electric Company, Schenectady 5, N. Y.

GENERAL ELECTRIC

HERE'S THE BASIS FOR A

MICROWAVE

TEST SETUP



A VERSATILE, dependable laboratory set-up for microwave testing can easily be built around these two Browning instruments.

The basis of a signal generator in the super-high-frequency range is provided in the Model TVN-7 square-wave modulator and power supply. This unit is used as a square-wave modulator at 600 to 2500 cycles for low-power velocity-modulated tubes, such as the 417A, 2K28, and 2K25. Provision is also made for external modulations: for grid pulse modulation at amplitudes up to 60 volts, and for reflector pulse modulation at up to 100 volts maximum. The power supply delivers regulated cathode voltage continuously variable from 280 to 480 volts, with provision for a 180-300 volt range.

Measurement of standing-wave ratios, with slotted lines, is easily accomplished with the Model TAA-16A amplifier — a high-gain a-c voltmeter, covering 500 to 5000 cycles per second. Front-panel controls can be set for broad-band or selective operation; sensitivities are: 15μv in broad-band and 10μv in selective position. The 4 inch output meter with illuminated scales is graduated in standing-wave voltage ratio and with a 0-10 linear scale. A panel switch is provided for convenience in applying bolometer voltage. The master gain control switch provides attenuation factors of 1, 10, and 100. Unit and regulated power supply are contained in black wrinkle steel cabinet 9 x 20 x 12 inches.

Both of these instruments are designed for 115-volt 50/60 cycle operation.

Write today for data sheets giving detailed specifications of the TVN-7 and TAA-16A equipments.

ENGINEERED FOR ENGINEERS

BROWNING
Laboratories, Inc.
Winchester, Mass.

Industrial Engineering Notes

(Continued from page 72A)

owners with it estimated that a minimum of 20,000 receivers could make the venture successful. . . . **The Swedish Television Committee has proposed the construction of two experimental TV stations** to be completed by July 1, 1954, according to reports reaching the Department of Commerce. The outlets would be in Stockholm and Uppsala and operate two hours per week until January 1, 1955, when transmission would be increased to eight hours per week. A license fee on receivers is proposed, starting in January, 1955. Stations also are proposed for the Goteborg area and the Province of Skane if the television experiments are a success.

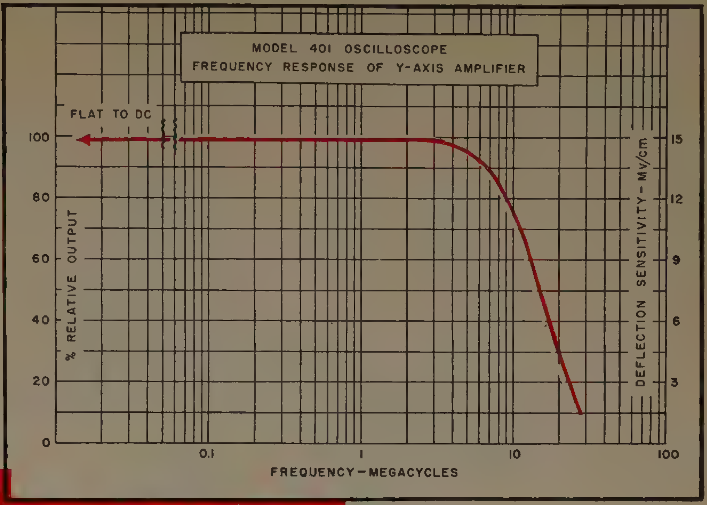
TELEVISION NEWS

State-wide networks of education television stations, which could lead to national and international networks, were envisaged by FCC chairman Paul A. Walker. The commissioner spoke at the 66th annual meeting of the Association of Land Grant Colleges and Universities, in Washington. Urging the educators to proceed rapidly in the television field, chairman Walker said, "I suggest that the goal should be the establishment of statewide networks in every one of the 48 states. If you do not have sufficient reservations for such a statewide network in your state, then you should move promptly to make an engineering survey and arrange to obtain additional channels—*if you are not already too late.*" . . . **The RTMA board of directors has adopted a resolution recommended by its Committee on Educational Television endorsing establishment of educational television stations and recommending to RTMA member-companies that they take individual action to encourage and promote this service** as "a vital force in American life." The board also approved the Committee's recommendations that the Committee continue to study educational television and make further recommendations to the directors as to ways and means of promoting the growth of educational television. . . . A program **designed to improve the technical proficiency and business technique of radio-TV service technicians** as developed by the RTMA Service Committee, under chairman R. J. Yeranko, was approved the Set Executive Committee and subsequently the RTMA board of directors at their Chicago meetings. The Service Committee vocational training programs has as its immediate objective the upgrading of television service technicians through existing vocational and trade schools. This is to be accomplished through the development and publication of manuals and teaching aids for schools and instructors which would reflect the recommendations of the radio-TV industry and to be consistent with the rapidly changing designs and products of the industry. . . . **The National Exhibitors Theatre Television Committee and the Motion Picture**

(Continued on page 76A)

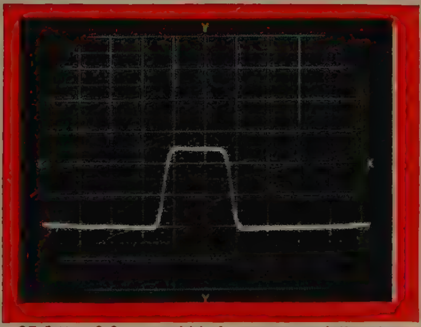
ONLY THE LFE 401 OSCILLOSCOPE

Offers all these Important Features

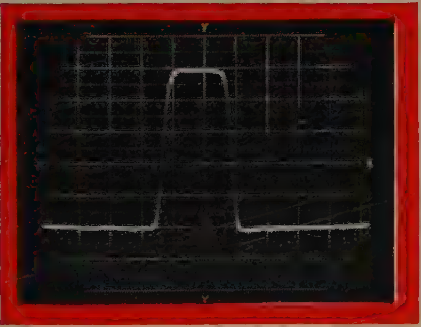


HIGH SENSITIVITY AND WIDE FREQUENCY RESPONSE OF Y-AXIS AMPLIFIER

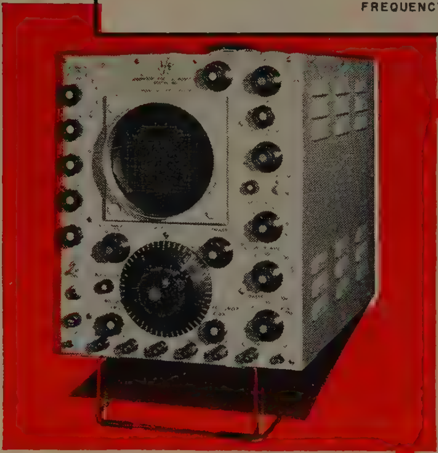
The vertical amplifier of the 401 has been designed to provide uniform response and high sensitivity *from D-C.* The accompanying amplifier response curve shows the output down 3 db. at 10 Mc. and 12 db. at 20 Mc. Alignment of the amplifier is for best transient response, resulting in no overshoot for pulses of short duration and fast rise time. Coupled with this wide band characteristic is a high deflection sensitivity of 15 Mv./cm. peak to peak at *both D-C* and A-C.



37.5 Mv., 0.2μ sec width, 1μ sec sweep full scale



75 Mv., 0.2μsec width, 1μsec sweep full scale



LINEARITY OF VERTICAL DEFLECTION The vertical amplifier provides up to 2.5 inches positive or negative uni-polar deflection without serious compression; at 3 inches, the compression is approximately 15%. The accompanying photographs illustrate transient response and linearity of deflection.

SWEEP DELAY The accurately calibrated delay of the 401 provides means for measuring pulse widths, time intervals between pulses, accurately calibrating sweeps and other useful applications wherein accurate time measurements are required.

The absolute value of delay is accurate to within 1% of the full scale calibration. The incremental accuracy is good to within 0.1% of full scale calibration.

SPECIFICATIONS

Y-Axis

Deflection Sens.—15 Mv./cm, peak-to-peak.

Frequency Response—DC to 10 Mc

Signal Delay—0.25μ sec

Input line terminations—52, 72 or 93 ohms, or no termination

Input Imp.—Direct—1 megohm, 30 μμf
Probe—10 megohms, 10 μμf

X-Axis

Sweep Range—0.01 sec/cm to 0.1 μ sec/cm

Delay Sweep Range—5-5000 μ sec in three adjustable ranges.

Triggers—Internal or External, + and –, trigger generator, or 60 cycles, undelayed or delayed triggers may be used.

Built-in trigger generator with repetition rate from 500-5000 cps.

General

Low Capacity probe

Functionally colored control knobs

Folding stand for better viewing

Adjustable scale lighting

Facilities for mounting cameras

Price: $895.00

Additional Features:

TRIGGER GENERATOR with variable repetition rate from 500 to 5000 cps.

POSITIVE & NEGATIVE UNDELAYED TRIGGERS and a **POSITIVE DELAYED TRIGGER** are externally available.

An **INPUT TERMINATION SWITCH** for terminating transmission lines at the oscilloscope.

A **FOLDING STAND** for convenient viewing.

FUNCTIONALLY COLORED KNOBS for easier location of controls.

Designed and built *for* electronic engineers, the 401, with its high gain and wide band characteristics, and its versatility, satisfies the ever-increasing requirements of the rapidly growing electronics industry for the ideal medium priced oscilloscope.

Write for Complete Information

L/E

LABORATORY for ELECTRONICS, INC.
75 PITTS STREET • BOSTON 14, MASS.

PRECISION ELECTRONIC EQUIPMENT • OSCILLOSCOPES • MAGNETOMETERS • COMPUTERS • MICROWAVE OSCILLATORS • MERCURY DELAY LINES

METALLIZED CERAMICS?

Please don't ask me where the many metallized "Lavite" Ceramic parts we have produced are used, because I just don't know — but I will be happy to solve any metallizing problem you may have. Perhaps you can profit from metallized ceramics in lower production costs because of less soldering and handling—maybe it is a more solid job you are seeking — and again you may wish to eliminate awkward and costly assembly soldering. Whichever it be — please feel free to send me the specifications on your job and I guarantee a cost and time saving solution. I would like to say "send for descriptive literature" but frankly I wouldn't know what to put into such literature — so, again I suggest you send me details of your requirements.

P.S. I can probably also be of considerable service to you on your ceramic problems — with precision produced "Lavite" Ceramics ("Lavite" Steatites, "Lavite" Ferrites and "Lavite" Titanates).

D. M. STEWARD MANUFACTURING CO.
3605 Jerome Ave. Chattanooga, Tenn.
Sales Offices in Principal Cities

Industrial Engineering Notes

(Continued from page 74A)

Association of America, which asked the FCC to allocate a 420-mc band to theatre television, has filed a statement with the Commission outlining where this allocation might be made. At the time of the hearing, FCC had asked for such a statement. "In order to give notice of these proposals to all interested persons," the Commission has released proposals from the statement of the theatre interests. The first proposal, in summary form, is as follows: (a) Allocate the frequencies from 5,925 to 6,285 mc for the use of theatre television. (b) Provide a reasonable transition period within which the present occupants of 5,925 to 6,285 mc can move to frequencies between 6,285 and 6,425 mc. (c) Consideration be given to the possibility of using the frequencies between 3,500 to 3,700 mc for the purpose of common carrier fixed operations. (d) Examination be made as to whether the land mobile services in 6,425 to 6,575 mc can be used for theatre television mobile pick-up. Proposal number 2 would classify theatre television as an industrial radio service on a frequency sharing basis and expand the 6,575 to 6,875-mc band downward to include 6,425 to 6,575 mc for theatre television requirements. If theatre television must share frequencies below 7,125 mc with other services on a nonpriority basis, it will be necessary to use frequencies above 10,700 mc, in larger centers of population. If frequencies are allocated for theatre television in bands above 10,700 mc, they should begin at 10,700 mc and progress upward from that point. We have not planned to make further or different allocation proposal. . . . The FCC adopted **a Notice of Proposed Rule Making which would amend the auxiliary TV broadcast rules (Part 4) to accommodate the needs for TV pickup,** studio-transmitter link and intercity relay stations in the UHF band, through reapportionment of channels for these auxiliary services, and to make other changes not covered in the present rules. . . . The Commission **has postponed further the hearing on the allocations of frequencies for theatre television from January 12, 1953 to January 26,** due to the anticipated shortage of hotel facilities in Washington during the inaugural period. . . . **KDUB-TV, Lubbock, Tex., which was granted an STA in October, 1952, started commercial** operation on November 6, 1952, as the fourth new station to get on the air. . . . **At Austin, Tex.,** KTBC-TV, on channel 7, received an STA for interim operation with 2 kw visual and 1 kw aural output power for November 15, 1952. . . . **Hawaiian Broadcasting System** Ltd., permittee of KGMB-TV, Honolulu, was authorized and started commercial operation on channel 9 with output power of 500 w visual and 250 w aural, December 1, 1952.

TV Station Grants

As of the end of November, 1952, The Federal Communications Commission had

(Continued on page 79A)

Industrial Engineering Notes

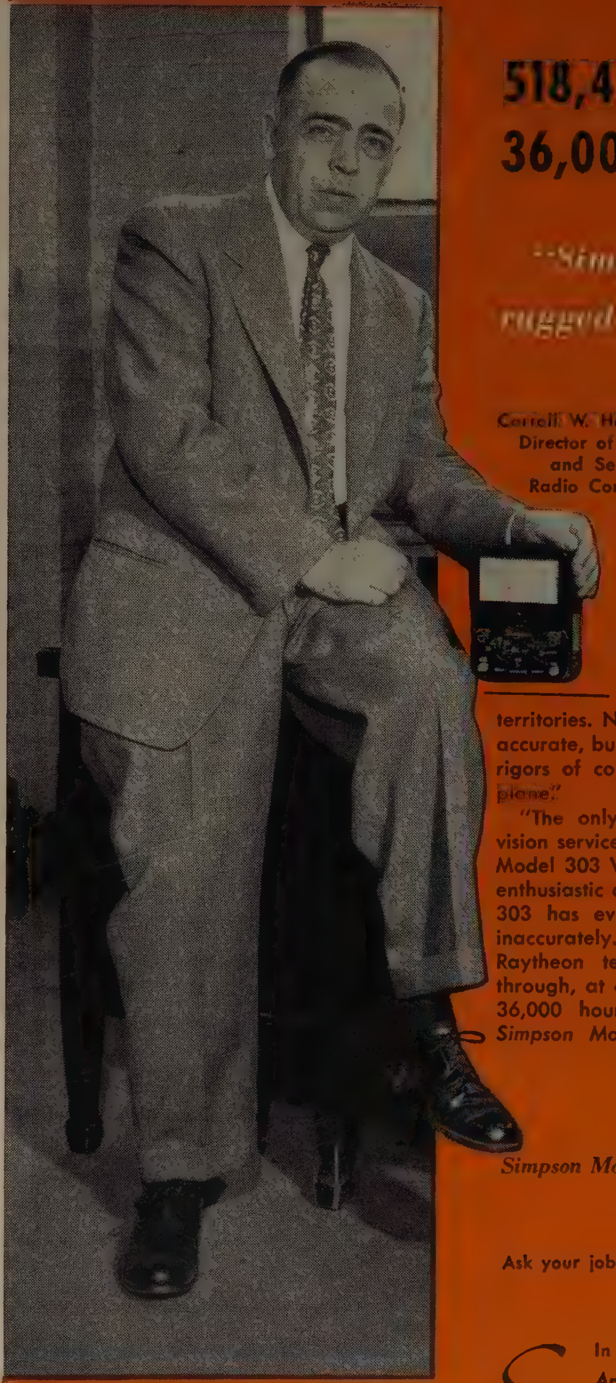
(Continued from page 76A)

granted a total of 230 construction permits for television stations. Of this number, 122 have been granted since the lifting of the "freeze" and the other 108 were already in operation.

During the last week in October, 1952, and first three weeks in November, 1952, construction permits were issued to the following stations:

Asheville, N.C., Radio Station WISE, Inc., channel 62 with 23 kw visual and 13 kw aural.
Atlantic City, N. J., Neptune Broadcasting Corp., channel 46 with 18 kw visual and 9 kw aural.
Battle Creek, Mich., Booth Radio & Television Stations, Inc., channel 64 with 24.5 kw visual and 14 kw aural.
Battle Creek, Mich., Michigan Broadcasting Co., channel 58 with 18.5 kw visual and 9.3 kw aural.
Belleville, Ill., Signal Hill Telecasting Corp., channel 54 with 220 kw visual and 120 kw aural.
Bethlehem, Pa., Associated Broadcasters, Inc., channel 51 with 2.25 kw visual and 2.25 kw aural.
Charleston, S. C., WCSC Inc., channel 5 with 100 kw visual and 50 kw aural.
Colorado Springs, Col., Pikes Peak Broadcasting Co., channel 13 with 11.5 kw visual and 5.8 kw aural
Decatur, Ill., Parairie Television Co., channel 17 with 18 kw visual and 9.8 kw aural.
Elmira, N.Y., Elmira Television, channel 24 with 58 kw visual and 29 kw aural.
Flint Mich., Trendle-Cambell Broadcasting corp., channel 16 with 59 kw visual and 29.5 kw aural.
Fort Smith, Ark., Southwestern Publishing Co., channel 22 with 265 kw visual and 145 kw aural.
Gadsden, Ala., Jacob A. Newborn, Jr., channel 21 with 22 kw visual and 11 kw aural.
Galveston, Tex., Gulf Television Co., channel 11 with 59 kw visual and 30 kw aural.
Galveston, Tex., Rudman Television Co., channel 41 with 230 kw visual and 120 kw aural.
Green Bay, Wis., Norbertine Fathers, channel 2 with 100 kw visual and 50 kw aural.
Greensboro, N. C., Inter-City Advertising Co. of Greensboro, N. C., channel 57, with 115 kw visual and 59 kw aural.
Henderson, Ky., Ohio Valley Television Co., channel 50 with 26 kw visual and visual and 13 kw aural.
Jackson, Mich., WIBM, Inc., channel 48 with 225 kw visual and 115 kw aural.
Johnstown, Pa., Rivoli Realty Co., channel 56 with 91 kw visual and 46 kw aural.
Lima, Ohio, WLOK, Inc., channel 73 with 20 kw visual and 11 kw aural.
Little Rock, Ark., Great Plains Television Properties, Inc., channel 23 with 17.5 kw visual and 9.9 kw aural.

(Continued on page 80A)



518,400 MILES
36,000 HOURS

"Simpson Model 303 is too rugged to break!"

Carroll W. Hoshour
Director of Sales Engineering
and Service Raytheon Television and
Radio Corporation

"Nine Raytheon television service representatives are constantly on the road covering 65 distributor territories. Not only must their equipment remain accurate, but it also must be built to withstand the rigors of constant travel by car, train, bus and plane."

"The only test instrument our Raytheon television service representatives carry is the Simpson Model 303 Vacuum Tube Volt-Ohmmeter. We are enthusiastic about this instrument because not one 303 has ever failed to operate or performed inaccurately. The Model 303's in service for Raytheon television representatives have gone through, at a rough estimate, 518,400 miles and 36,000 hours of rigorous handling. We think *Simpson Model 303 is too rugged to break."*

Simpson Model 303 Vacuum Tube Volt-Ohmmeter
dealer's net . . . $58.75
HV Probe $9.95
RF Probe $7.50

Ask your jobber for full information or write:
Simpson Electric Company
5200 West Kinzie Street
Chicago 44, Illinois CO 1-1221
In Canada: Bach-Simpson, Ltd., London, Ont.

Another reason why
Simpson *is the world's largest manufacturer of test equipment*

BURTON BROWNE ADVERTISING

Prodelin

WAVEGUIDE

conserves POWER
in
UHF-TV!

UHF POWER LOSS
WITH 3⅛" COAXIAL TRANSMISSION LINE

Length of Transmission Line	Total Loss	ERP*	Approximate Power Loss
1000 ft.	3 db	50 kw	50 kw
500 ft.	1.5 db	70.7 kw	29.3 kw
100 ft.	0.3 db	93.5 kw	6.5 kw

*Assuming 100 kw ERP with a perfect transmission line

Small increments of attenuation in coaxial transmission lines result in excessive power losses when used in conjunction with hi-gain antennas in the UHF range. This loss of effective radiated power is often as high as 50%.

The best solution to the problem is *waveguide*. Waveguide provides lower attenuation, greater coverage for equal antenna height . . . it can be used in combination with UHF coaxial line . . . requires no dehydration or pressurization.

Prodelin has pioneered the manufacture and development of UHF waveguide, and stands ready to assist you in all phases of this important new development. Write for Chart TC-1256, *Attenuation of Coaxial Lines and Waveguide in the UHF Range*, and for information related to your specific needs.

pdc

The World's Finest Coaxial Transmission Lines & Waveguides

PRODUCT DEVELOPMENT COMPANY, INC.
307 BERGEN AVENUE KEARNY, NEW JERSEY

Manufacturers of Antennas, Transmission Lines and Associated System Facilities

Industrial Engineering Notes

(*Continued from page 79A*)

Lynchburg, Va., Lynchburg Broadcasting Corp., channel 13 with 28 kw visual and 14 kw aural.

Lynchburg, Va., Old Dominion Broadcasting Corp., channel 16 with 100 kw visual and 57 kw aural.

Muncie, Ind., Tri-City Radio Corp., channel 49 with 16 kw visual and 8.1 kw aural.

Pensacola, Fla., Southland Telecasters, channel 15 with 20 kw visual and 10 kw aural.

Pueblo, Col., Pueblo Radio Co., Inc., channel 3 with 10.5 kw visual and 5.3 kw aural.

Pueblo, Col. The Star Broadcasting Co., Inc., channel 5 with 12 kw visual and 6 kw aural.

San Bernardino, Calif., KITO, Inc., channel 18 with 87 kw visual and 49 kw aural.

Santa Barbara, Calif., Santa Barbara Broadcasting and Television Corp., channel 3 with 50 kw visual and 25 kw aural.

Sioux City, Iowa, Cowles Broadcasting Co. channel 9 with 29 kw visual and 15.5 kw aural.

Sioux City, Iowa Great Plains Television Properties, Inc., channel 36 with 18.5 kw visual and 10.5 aural.

Sioux Falls, S. D., Midcontinent Broadcasting Co., channel 11 with 57 kw visual and 29 kw aural.

Tucson, Ariz., Arizona Broadcasting Co., Inc., channel 4 with 11 kw visual and 5.5 kw aural.

Tucson, Ariz., Old Pueblo Broadcasting Co., channel 13 with 316 kw visual and 160 kw aural.

Waco, Tex., Central Texas Television Co., channel 34 with 5 kw visual and 3 kw aural.

Warren, Ohio, Warren Tribune Radio Station, Inc., channel 67 with 80 kw visual and 43 kw aural.

Waterbury, Conn., WATR, Inc., channel 53 with 245 kw visual and 125 kw aural.

Wichita Falls, Tex., White Television Co., channel 22 with 18.5 kw visual and 9.3 kw aural.

Williamsport, Pa., WRAK, Inc., channel 36 with 21 kw visual and 10.5 kw aural.

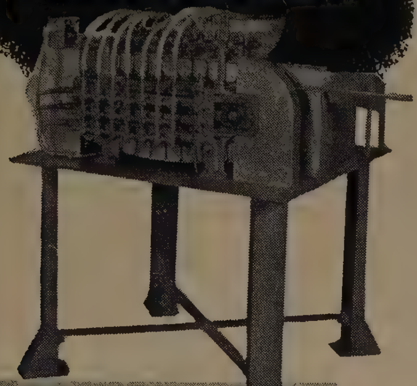
SECTION MEETINGS

AKRON

"A Correlation Computer," by E. W. Hix, Goodyear Aircraft Corporation; October 21, 1952.

"Good Engineering Practices in the application of subminiature tubes," by E. F. Kahl, Sylvania Electric Products, Inc.

(*Continued on page 81A*)



experience... still the best teacher!

A large manufacturer of miniature lamps for switchboard and telephone use, came to Kahle recently with a production problem. The client had been using a low-production tube bottoming machine that required frequent adjustment and maintenance due to its method of uneven shifting of the tubing. This also caused excessive tube breakage within the machine and a high reject rate on the finished tubes. Kahle's solution was to build the fully automatic machine shown above, Model 2048. This machine, producing 4,000 units per hour, eliminates the lifting of the glass from one position to the next by using a continuous conveyor principle. The glass is indexed straight through the machine and is not 'jumped' or 'bumped' in the process. In-machine breakage and rejects are held to a minimum. In addition, Model 2048 is ideal for production of round or flat bottomed test tubes, vials and containers.

If your production involves special-purpose machinery, learn—without obligation—how Kahle's more than 40 years of practical experience can benefit you. Write Kahle today.

Kahle
ENGINEERING COMPANY
1312 SEVENTH STREET
NORTH BERGEN N. J.

SECTION MEETINGS

(Continued from page 80A)

ATLANTA

"Health Aspects of Radiation," By J. H. Tolan, Georgia Institute of Technology; October 24, 1952.

BALTIMORE

"Radio and TV Interference" by P. F. Rand, Remington-Rand Laboratories; November 12, 1952.

BEAUMONT-PORT ARTHUR

"Developments in Aircraft Communication," by F. J. Maclary, Collins Radio Company; October 29, 1952.

"Television Service Clinic," By Jim Brown, Sparton Television Company; November 12, 1952.

BINGHAMTON

"Linear Variable Differential Transformers," by H. J. Schaevitz Engineering, Inc.; October 23. 1952.

BOSTON

"A General Survey of Millimeter Wave Techniques," by Dr. R. D. Kodis, Harvard University; October 16, 1952.

BUFFALO-NIAGARA

"Design of Video Amplifiers for Optimum Transient Response," by Harold Newman and W. K. Squires, both of University of Buffalo and consultants to Sylvania Electric Products, Inc.; October 15, 1952.

"Medical Electronics," by Wilson Greatbatch, Cornell Aeronautical Lab. Inc. and Dr. Leonard Wolin, Buffalo General Hospital; November 19, 1952.

CEDAR RAPIDS

"Radio Astronomy," by Dr. D. O. McCoy, Collins Radio Company; "Instrument Landing System Steering Computer," by E. H. Fritze and W. G. Anderson, Collins Radio Company; and "The Status of TV in Cedar Rapids," by R. D. Yoakam of KCRG-KCRK; October 22, 1952.

"Should Engineers turn to Biology for New Ideas," by Dr. O. H. Schmitt, University of Minnesota; film, "Collins Integrated Flight System," November 12, 1952.

CHICAGO

"Magnetic Amplifiers for Industrial Control," by L. W. Buechler, Vickers, Inc.; October 17, 1952.

CINCINNATI

"Radar Speed Control," by Col. S. R. Schrotel, Chief of Police and J. L. Hearn, Director of Comm., City of Cincinnati; October 21, 1952.

CLEVELAND

"Electronic Radio Field Strength Analyzer," by F. W. Smith, NBC and "VHF Tropospheric Recording Measurements," by J. S. Hill, United Broadcasting Company; October 23, 1952.

CONNECTICUT VALLEY

"Interference Problems in F-M" by Dr. L. B. Arguimbau, Massachusetts Institute of Technology; September 18, 1952.

"Analog Computers," by R. D. McCoy, Reeves Instrument Corporation; October 16, 1952.

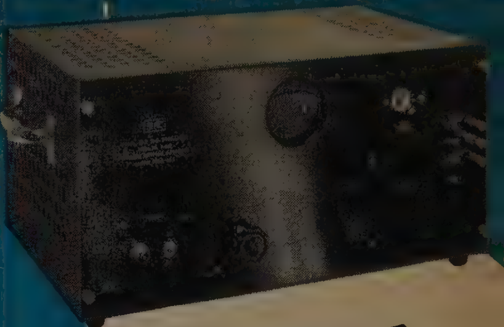
DALLAS-FORT WORTH

Tour of L. D. Telephone Plant; September 23, 1952.

"Recent Trends in Oscilloscope Design," by C. V. Sanford, Tecktronix, Inc.; November 6, 1952.

"Present Status of the Capacitor and Resistor Art as applied to Electronic Components" by Leon Podolsky, Sprague Electric Company; November 20, 1952.

(Continued on page 82A)



when you need a
Quality Oscillator
SIE
MODEL M-2 OSCILLATOR
is your answer
low distortion... wide range

The unique SIE oscillator circuit which has no lower limit to its possible frequency of oscillation is responsible for the excellent low frequency performance of the Model M-2 and other SIE oscillators.

SPECIFICATIONS
Range: 1 cps to 120,000 cps.
Calibration: Within 1½% plus 1/10 cycle
Output circuits: 20 volts or 20 millamps and 1 volt at 300 ohms constant impedance
Amplitude stability: Plus or minus ½ db

UNDESIRED VOLTAGES
Power Supply Noise: Less than 1/100% of output signal
Power Line Surge: Less than 1/10% of output signal
Harmonic Distortion: Less than 2/10% from 20 cps to 15,000 cps. Less than 1% at all other frequencies
Microphonic Noise: Less than 1/100% of output signal

SOUTHWESTERN INDUSTRIAL ELECTRONICS COMPANY

world's largest Ion Trap maker
offers lowest priced Ion Trap
on the market

NEW SIMPLIFIED CONSTRUCTION

MODEL T-312. The new simplified steel construction lowers manufacturing costs by fully utilizing, for the first time, the Alnico permanent magnet's maximum efficiency. This makes Model T-312 the lowest priced ion trap on the market. Installs in only 2-3 seconds—just slip on.

FEATURES OF BOTH MODELS

STAYS PUT—No wobble; no shift during shipment; no realignment necessary when your TV set is installed in the home.

EASILY ADJUSTED—Slides more uniformly over tube's neck due to metal-to-glass contact.

STABILIZED AND TESTED on special equipment designed and used only by Heppner, each individual Heppner Ion Trap is guaranteed to meet your working requirements.

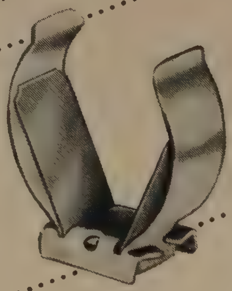
UNUSUALLY FAST DELIVERY.

LIGHTWEIGHT—Snap-On Model weighs only ½ ounce; Slip-On Model only 3/5 ounce. Will not harm tube's neck.

ALNICO P.M. USED—Retains magnetism indefinitely.

SNAP-ON ION TRAP

installs instantly—just snap on—stays put



MODEL E-437. Saves you expensive production manhours with EXCLUSIVE instant snap-on feature. Reduces your parts costs because priced below competition. Clamp-type construction of Hardened Spring Steel.

Heppner has built over 15,000,000 ion traps to date

Write today for further information on better ion traps at lower prices.

HEPPNER
MANUFACTURING COMPANY
Round Lake, Illinois (50 Miles Northwest of Chicago)
Phone: 6-2161
SPECIALISTS IN ELECTRO-MAGNETIC DEVICES

Representatives: **John J. Kopple**
60 E. 42nd St., New York 17, N.Y.
James C. Muggleworth
506 Richey Ave., W., Collingswood, N. J.
Ralph Haffey
2417 Kenwood Ave., Ft. Wayne 3, Indiana
Irv. M. Cochrane Co.
408 So. Alvarado St., Los Angeles, Calif.

SECTION MEETINGS

(Continued from page 81A)

DAYTON

"Lightning and Spherics as Environmental Factors in Aircraft Operations," by M. M. Newman, Lightning and Transient Research Laboratory; November 13, 1952.

DENVER

"The Transistor; Successor to the Vacuum Tube?" by John Doremus, Motorola, Inc.; October 28, 1952.

DES MOINES-AMES

A Practical Binural Recording System," by O. C. Bixler, Magnecord, Inc.; November 6, 1952.

DETROIT

"Just for Fun," by Nate Reiss, Reiss Public Address Systems, Inc.; September 19, 1952.

"Voice of America Broadcasts," by J. L. Hollis, Collins Radio Company; October 17, 1952.

Description of Electronic Equipment in WWJ-TV Studios, followed by tour of building conducted by L. A. Spragg, Chief Facilities Engineer; November 21, 1952.

EL PASO

"Techniques of Measuring Position and Velocity by Radio," by Dr. J. W. Muehlner, Holloman Air Force Base; October 24, 1952.

EVANSVILLE-OWENSBORO

"Industrial Application of Ultrasonics," by G. E. Henry, General Electric Company; October 8, 1952.

FORT WAYNE

"Design of Radio Station WOWO Studios," by B. H. Ratts, WOWO and WOWO FM Westinghouse Radio Stations, Inc.; November 6, 1952.

HAMILTON

Plant tour of T. S. Farley Ltd. (designer and manufacturer of coils and transformers for radio and television); October 27, 1952.

KANSAS CITY

"Electronic Trends ot Tomorrow," by Dr. J. D. Ryder, Faculty University of Illinois; November 11, 1952.

LITTLE ROCK

"Microwaves in Pipeline Operation," by M. E. Nider, Texas-Illinois Gas Pipeline Co.; October 23, 1952.

LONDON

"Background to Computer Technique," by Dr. Gottleib, University of Toronto; October 21, 1952.

"Low Noise Input Circuits," by A. C. Hudson, National Research Council; November 3, 1952.

"Electronic Musical Instruments," by R. H. Tanner, Northern Electric; November 18, 1952.

LOS ANGELES

"Some Comparisons in the Behavior of Microwaves and Light Waves," by Dr. M. E. Strieby, American Telephone and Telegraph Company; November 4, 1952.

LOUISVILLE

"Ultra-Sonics," by George Henry, General Electric Laboratories; October 9, 1952.

Tour of Girdler Corporation Thermex Division plant conducted by T. L. Wilson, C. E. Ellsworth and R. R. Moore; November 13, 1952.

MILWAUKEE

Trip through Wisconsin Telephone Company Toll Office; October 27, 1952.

(Continued on page 84A)

IDEAS
in the making

Araldite Bonding and Casting Resins developed by Ciba Research are simplifying manufacturing methods, improving product efficiency, and opening new fields of product development. You will want to know more about them.*

ARALDITE® BONDING RESINS

ARALDITE® TYPE	CURING CONDITIONS	PHYSICAL APPEARANCE	BOND STRENGTH* ALUMINUM-ALUMINUM (LB./SQ. IN.)	SUGGESTED USE
AN-101	Room temperature	High viscosity liquid	2000-2500	Bonds or seals glass-metal.
AN-102	Room temperature	Low viscosity liquid contains solvents	1400-1600	Bonds metal-metal and metal-wood.
AN-111	Heat cure	Low viscosity liquid contains solvents	2000-2500	Impregnating (vacuum method), laminating and bonding.
AN-115	Heat cure	Low viscosity liquid contains solvents	2500-3000	Impregnating, laminating and bonding.
AN-106	Heat cure	Heavy paste silver color	3000-3200	Bonds socket-type joint.
AN-107	Heat cure	Heavy paste tan color	3000-3200	Bonds socket-type joint.
AN-112	Heat cure	Heavy paste tan color	2500-3000	Laminating, bonding. Rapid cure.
AN-100	Heat cure	Powder tan color	4000-4500	Bonds { Heat-resistant, smooth, non-porous materials . . . metal-metal, metal-glass, metal-ceramic, glass-glass
AN-110	Heat cure	Powder silver color	4000-4500	
AN-120	Heat cure	Stick tan color	4000-4500	
AN-130	Heat cure	Stick silver color	4000-4500	
AN-104	Room temperature	Non-flowing paste tan color	1000-1500	Bonds loose-fitting joints.
AN-103	Heat cure	Non-flowing paste tan color	1200-1400	Bonds loose-fitting joints.

*ASTM D1002-49T

ARALDITE® CASTING RESINS

ARALDITE® TYPE	CURE	PHYSICAL APPEARANCE	SUGGESTED USE	SHRINKAGE	ELECTRICAL PROPERTIES
CN-501	Heat cure	Amber solid	Casting, potting, encapsulating. Good adhesion	Very low ½ to 2%	Excellent
CN-502	Room temperature or heat cure	Thin liquid	Casting, potting, encapsulating. Good adhesion.	Very low ½ to 2%.	Good
CN-503	Room temperature or heat cure	Liquid	Similar to Araldite CN-501. Low temperature. Pour	Very low ½ to 2%.	Excellent
CN-504	Heat cure	Very thin liquid	Impregnating, casting, potting, encapsulating. Good adhesion.	Low < 2%.	Good

SEND THIS COUPON . . . or write us on your company letterhead . . . for complete technical data on the physical properties and recommended procedures for the successful use of Araldite Resins for your own fabricating needs.

**Reg. U.S. Pat. Off.*

Ciba *Plastics*

★BONDING ★CASTING ★COATING RESINS

CIBA COMPANY INC., PLASTICS DIVISION
627 Greenwich St., New York 14, N. Y.
(In Canada: Ciba Co. Ltd., Ciba Bldg., Montreal)

Please send me Ciba Plastics Technical Bulletins for

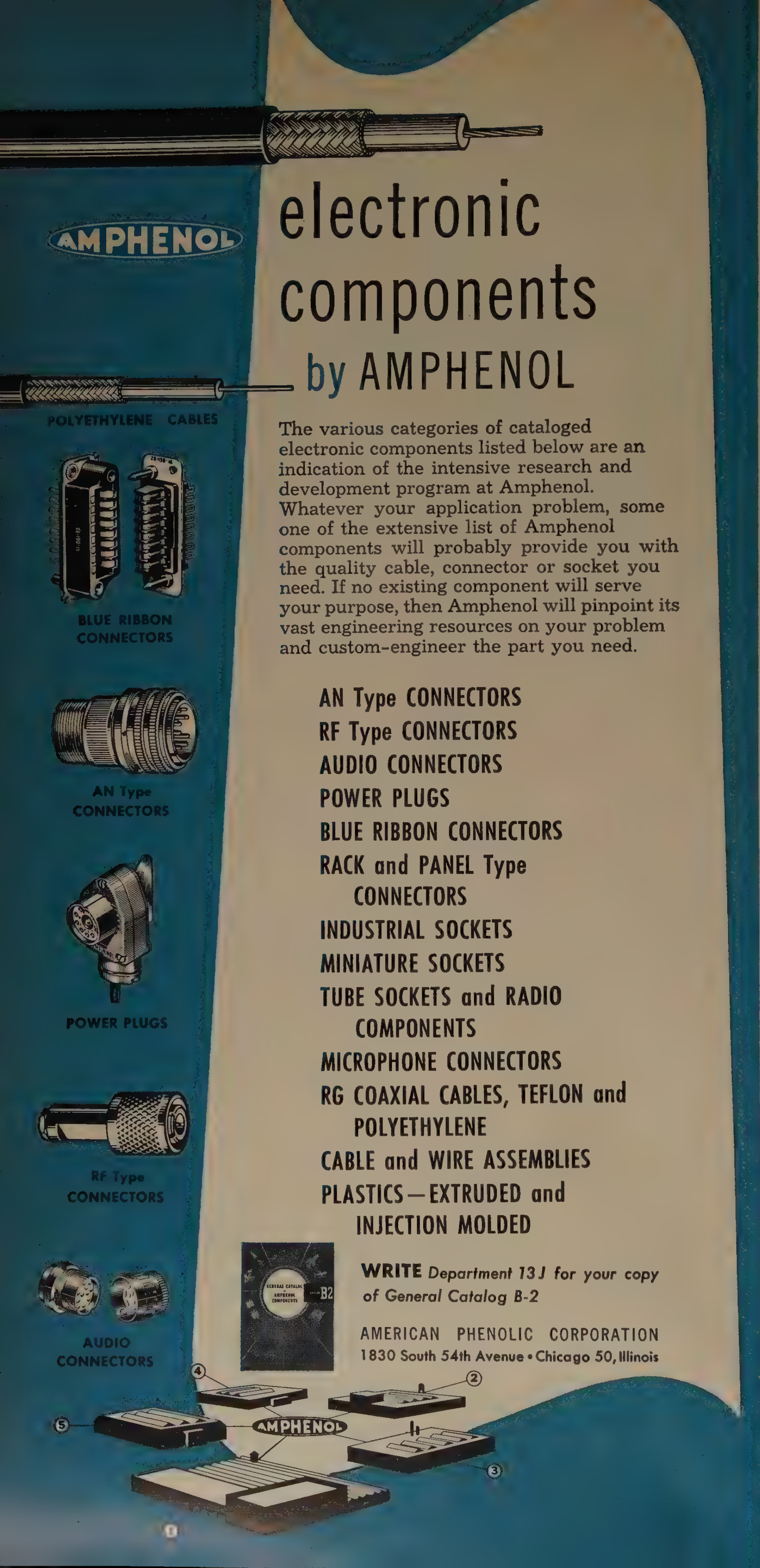
BONDING ☐ CASTING ☐ COATING ☐

*Name*________________________

*Company*____________ *Title*____________

*Address*________________________

I.R.E.-1



electronic components by AMPHENOL

The various categories of cataloged electronic components listed below are an indication of the intensive research and development program at Amphenol. Whatever your application problem, some one of the extensive list of Amphenol components will probably provide you with the quality cable, connector or socket you need. If no existing component will serve your purpose, then Amphenol will pinpoint its vast engineering resources on your problem and custom-engineer the part you need.

- AN Type CONNECTORS
- RF Type CONNECTORS
- AUDIO CONNECTORS
- POWER PLUGS
- BLUE RIBBON CONNECTORS
- RACK and PANEL Type CONNECTORS
- INDUSTRIAL SOCKETS
- MINIATURE SOCKETS
- TUBE SOCKETS and RADIO COMPONENTS
- MICROPHONE CONNECTORS
- RG COAXIAL CABLES, TEFLON and POLYETHYLENE
- CABLE and WIRE ASSEMBLIES
- PLASTICS—EXTRUDED and INJECTION MOLDED

WRITE *Department 13J for your copy of General Catalog B-2*

AMERICAN PHENOLIC CORPORATION
1830 South 54th Avenue • Chicago 50, Illinois

SECTION MEETINGS

(Continued from page 82A)

New York

"Electronic Equipment and Services for the New United Nations Headquarters," by H. B. Rantzen, UN Telecommunications; October 1, 1952.

Inspection Trip of United Nations Facilities in New York; October 8, 1952.

North Carolina-Virginia

"Nuclear Reactor Control," by Dr. L. R. Quarles, University of Virginia; October 24, 1952.

Ottawa

"Microwave Optics," by G. A. Woonton, Faculty, McGill University; October 23, 1952.

Pittsburgh

"Recent Advances in Pulse Generation Systems for Radar and Geophysical Prospecting," by Dr. J. B. Woodford and F. C. Alexander of Carnegie Institute of Technology and Gulf Research Laboratories, respectively; November 10, 1952.

Portland

"Upper Ionosphere Research," by Dr. Marcus O'Day, Air Force Cambridge Research Laboratory; September 3, 1952.

"Television Network Transmission," by Dr. M. E. Strieby, managing Editor of Bell System Technical Journal and Director of Technical Demonstrations; October 14, 1952.

Princeton

"Radio Astronomy," by Dr. J. P. Haegen, National Bureau of Standards; November 13, 1952.

San Diego

"IRE Activities and Planning," by Dr. D. B. Sinclair, President, IRE; August 26, 1952.

"Television Networks," by Dr. M. E. Strieby, Managing Editor of Bell System Technical Journal and Director of Technical Demonstrations; October 29, 1952.

San Francisco

"Bell System Television Networks," by Dr. Maurice Strieby, Director of Technical Demonstrations and Managing Editor of the Bell System Technical Journal; October 20, 1952.

Syracuse

"The All Glass Television Bulb," by J. P. Kearney and Dr. H. B. Vincent, Kimble Glass Company; October 20, 1952.

"Military Communications in Korea," by J. W. Nelson, Jr. General Electric Company; November 17, 1952.

Toledo

Films, "And a Voice Shall be Heard" and "Television Lighting"; November 13, 1952.

Toronto

"Audio Reproduction," by D. T. N. Williamson, Ferranti Ltd. of England; October 20, 1952.

"Electronics in Medicine," by Dr. R. H. Lowery, Defence Research Medical Laboratories; November 17, 1952.

Tulsa

"Electronic Trends of Tomorrow," by Dr. J. D. Ryder, University of Illinois; November 12, 1952.

"The Present Status of the Capacitor and Resistor Art as Applied to Electronic Components," by Dr. Leon Podolsky, Sprague Electric Company; November 19, 1952.

(Continued on page 86A)

DALIS DELIVERS

IMMEDIATELY... FROM STOCK...

The NEW

RAYTHEON Junction-Type TRANSISTORS

ORDERS FILLED IN SEQUENCE OF RECEIPT... SO,

Don't Delay!

PHONE: ALgonquin 5-3000
WRITE or WIRE: Dept. IND
TELETYPE: N. Y. 1-2482

Write for Free Technical Bulletins

Seal of ALD *Service*

H. L. DALIS INC.

WHOLESALE DISTRIBUTORS
ELECTRONIC EQUIPMENT
175 VARICK ST., NEW YORK 14

SERVING THE TRADE FOR OVER A QUARTER CENTURY

---

for **YOUR** *product*

WHICH PILOT LIGHT DO YOU NEED?

ACTUAL SIZE
Cat. #613529-211

THE BIG ONE

This Pilot Light Assembly was first made to accommodate the *S-11 lamp* and was intended for use in the cabs of great diesel locomotives.

or

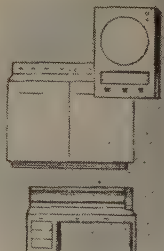
ACTUAL SIZE
Cat. #8-1930-621

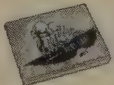
THE LITTLE ONE

The miniaturization program on defense products required the development of this *sub-miniature* light. It is used on communication equipment and aircraft. Midget flanged base bulbs to fit are rated 1.3, 6, 12, and 28 volts.

Dialco HAS THE COMPLETE LINE of INDICATOR and PANEL LIGHTS

Samples to suit your own special conditions and requirements will be sent promptly and *without cost.* Just outline your needs. Let our engineering department assist in selecting the *right lamp* and the *best pilot light* for YOU.





Write for the Dialco HANDBOOK of PILOT LIGHTS

Foremost Manufacturer of Pilot Lights

DIALIGHT CORPORATION

60 STEWART AVENUE, BROOKLYN 37, N. Y.
HYACINTH 7-7600

GET THE INSIDE STORY

...WHEN YOU BUY FILTERS

RESPONSE CURVES and cases may look alike, but component quality and internal construction are the things that determine dependability—in a filter, and in the associated equipment.

TO BE SURE components are the best, Lenkurt presses its own cores, winds the coils, and subjects all parts to the most rigorous checks possible.

IN A LENKURT FILTER, parts are firmly fastened to sturdy headers, connections made to rigid terminal boards. Units are impregnated, cased, and/or hermetically sealed as required.

LENKURT FILTERS are engineered and built to your most exacting specifications on delivery schedules to meet any quantity need by Lenkurt Electric Company—largest independent manufacturers of telephone toll transmission equipment.

LENKURT ELECTRIC
SALES COMPANY
San Carlos 2 California

Lenkurt

SECTION MEETINGS

(Continued from page 84A)

Twin Cities

"High Fidelity Sound Reproduction—Past and Future," by Marvin Camras, Armour Research Foundation; October 28, 1952.

"Ferroelectrics and the Dielectric Amplifier," by Dr. R. M. Smith, Minneapolis Honeywell Regulator Company; November 19, 1952.

Vancouver

"Electronic Controls for the Fraser River Model," by Mr. Ian Smith; October 20, 1952.

Washington, D.C.

"Micro-Strip Printed Circuits for the Kilomegacycle Range," by Dr. F. Assadourian, Federal Telecommunication Laboratories, Inc.; November 10, 1952.

Williamsport

"Research in Electronics Production," by W. H. Hannahs, Sylvania Electric Products, Inc.; October 22, 1952.

SUBSECTIONS

Amarillo-Lubbock

"Television for Lubbock and the South Plains," by R. F. Lee, KCBD and KCBD-TV; November 12, 1952.

Lancaster

"Ultrasonic Waves and Their Applications," by P. D. Goodman, Brush Development Company; November 12, 1952.

Long Island

"Microwave Spectroscopy," by L. E. Norton, RCA; October 14, 1952.

Mid-Hudson

"Radio Aids to Navigation," by Major Waterman, West Point, USAF; October 21, 1952.

Northern New Jersey

"Feedback Theory—Some Properties of Signal Flow Graphs," by Samuel Mason, Faculty, Massachusetts Institute of Technology; October 8, 1952.

Rome

"Digital Computers," by S. N. Alexander, NBS; November 17, 1952.

Wichita

"Television Interference," by H. W. Bourell, FCC; September 18, 1952.

STUDENT BRANCH MEETINGS

University of Alberta (IRE-AIEE)

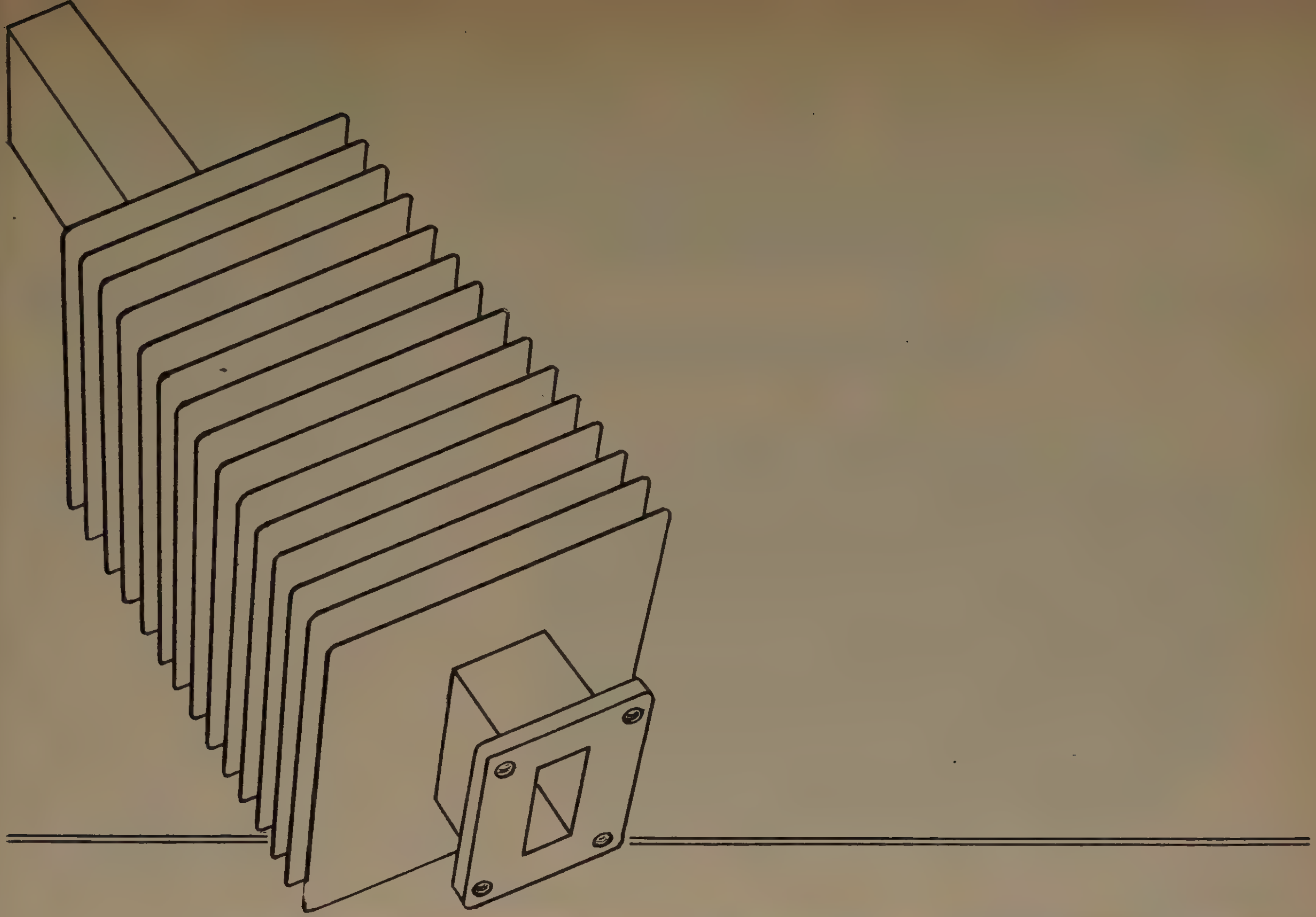
"The War of Words," by L. E. Gods, Secretary of Faculty of Engineering, University of Alberta; October 23, 1952.

"Leonardo da Vinci," by J. W. Porteus, Faculty, University of Alberta; November 6, 1952.

University of California (IRE-AIEE)

"Do We Have Enough Time for the UCSEE," by Professor R. A. Bruns, Faculty, University of California.

(Continued on page 88A)



New Ceramic Lossy Material Means Greater Efficiency in these Waveguide, High Power Terminations, and Attenuators

"Eilex", a new ceramic lossy material, is now available in waveguide, high power terminations and attenuators from Electro-Impulse Laboratory.

This new material is extremely durable, provides a strong adhesive bond to waveguide walls, withstands temperatures up to 2500° F., and handles the thermal shock efficiently.

The waveguide loads use walls that are poor conductors, which means a more efficient removal of the heat generated in the load, and less tendency toward pulsepower breakdown (arcing) as may occur in designs which use filling material in the waveguide.

Attenuators are accurately calibrated and may be used as a termination and power measuring device in conjunction with a thermister bridge.

For details, write Department "A".

Type	Freq Range KMC	Waveguide in *inches*	Nominal* Average Power Dissipation	Maximum V.W.S.R.	Size in *inches*	Weight	Flange
			DUMMY LOADS				
HPTK100	18-26.50	½ x ¼	60 W.	1.15	8 long	2 lbs.	UG425/U
DA22/U	8.2-12.4	1.2 x 1	175 W.	1.15	11 x 2.5 x 2.5	3 lbs.	UG39/U
HPTXS250	8.2-12.4	½ x 1	250 W.	1.15	11 x 3.5 x 3.5	3¼ lbs.	UG39/U
HPTXS150	8.2-12.4	½ x 1	150 W.	1.15	11 x 2.5 x 2.5	3 lbs.	UG39/U
HPTXS75	8.2-12.4	½ x 1	75 W.	1.15	11 long	2½ lbs.	UG39/U
DA21/U	7-10	1¼ x ⅝	280 W.	1.15	11.5 x 3.5 x 3.5	6 lbs.	UG51/U
HPTXL250	7-10	1¼ x ⅝	250 W.	1.15	12 x 3.5 x 3.5	3¼ lbs.	UG51/U
HPTXL200	7-10	1¼ x ⅝	200 W.	1.15	11.25 x 2.75 x 2.75	2 lbs. 4 oz.	UG138/U
HPTXL100	7-10	1¼ x ⅝	100 W.	1.15	10 long	2 lbs.	UG51/U
HPTXL500	7-10	1¼ x ⅝	450 W.	1.15	11.25 x 4.5 x 4.5	5¼ lbs.	UG51/U
HPTX600	5.85-8.20	1½ x ¾	600 W.	1.15	14 long	8 lbs.	UG344/U
HPTX800	3.95-5.85	2.00 x 1.00	800 W.	1.15	14 long	12 lbs.	UG149A/U
TS 338	2.4-3.7	1.5 x 3	700 W.	1.1	24 x 5.4 x 5.4	13 lbs.	UG438/U
HPTS1500	2.60-3.95	3.00 x 1.50	1500 W.	1.15	25 long	13 lbs.	UG438/U
HPTL1500	1.70-2.60	4.46 x 2.31	1500 W.	1.15	15 long	20 lbs.	UG435/U
HPTL2000	1.12-1.70	6.66 x 3.41	2000 W.	1.15	32 long	24 lbs.	UG417/U
			ATTENUATORS				
HPAXS	8.2-12.4	1.2 x 1.00	250 W.	1.15	Attenuation 2-60 decibels (fixed)		UG39/U
HPAXL	7.00-10	1¼ x ⅝	450 W.	1.15	Attenuation 2-60 decibels (fixed)		UG51/U

* Without the use of water or forced air cooling.

ELECTRO IMPULSE Laboratory

62 WHITE STREET • RED BANK, N.J.
RED BANK 6-0404

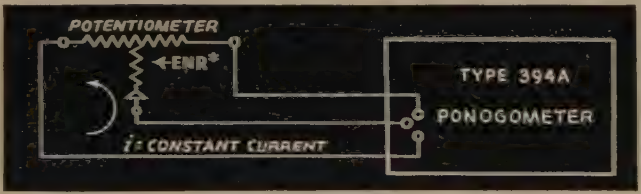
TIE-TALKS
FEATURE

Type 394-A
PONOGOMETER
Precision Potentiometer Noise Tester

Designed as a production and laboratory test instrument by the Technology Instrument Corporation for quality control in the manufacture of their precision potentiometers, the Type 394-A Ponogometer is now available for such uses as:

1. Incoming inspection of single or multi-turn potentiometers.
2. To establish noise-performance criteria for precision potentiometers in servo, control, or instrumentation applications.
3. For laboratory investigations and/or quality control in single or multi-turn potentiometer manufacturing.

Working to a definition‡ of noise covering, in part, the voltages created by the equivalent, transient contact noise resistance appearing between the wiper and resistance element of a precision potentiometer, the 394-A Ponogometer monitors this contact resistance, providing an audible and visual indication when a prescribed threshold level is exceeded.



SPECIFICATIONS

Range: Equivalent Noise Resistance*—threshold level adjustable from 10 to 5000 ohms. Lower levels can be set up by means of accessory amplifiers.

Wiper Exciting Current: Constant 1 milliampere. Other values can be set up by means of accessory current sources.

Type Indication: Audible tone and a neon light, essentially independent of speed of operation of total resistance, and resistance function of potentiometer.

Write for specifications and further details in ‡Laboratory Report No. 6

TECHNOLOGY INSTRUMENT CORP.

535 Main Street, Acton, Mass. Tel. Acton 3-7714

STUDENT BRANCH MEETINGS

(Continued from page 86A)

"Field Trip to KGO television studios; October 16 and 17, 1952.

"Apples are Falling," by W. E. Herrmann, General Electric Company; October 28, 1952.

California Institute of Technology (IRE)

"Atomic Standards," by Dr. R. D. Huntoon, National Bureau Standards; November 10, 1952.

Case Institute of Technology (IRE)

"Einstein's Theory of Relativity," by Dr. F. E. Brammer, Faculty, Case Institute of Technology; October 14, 1952.

"Servo-Mechanisms," by Dr. J. H. Moran, Faculty, Case Institute of Technology; October 28, 1952.

University of Colorado (IRE-AIEE)

Films, "Steam for Power" and "The 1951 World Series," October 22, 1952.

"The Master Control Traffic System used in Denver, Colorado," by J. B. Rudden; November 5, 1952.

Columbia University (IRE-AIEE)

"The Purpose of the Electrical Engineering Society," by Professors J. B. Russell and J. R. Ragazzini, Faculty, Columbia University; October 24, 1952.

University of Connecticut (IRE-AIEE)

"Opportunities in Selling," by C. J. Gladfelter, Faculty, University of Connecticut; October 30, 1952.

Cooper Union School of Engineering (IRE-AIEE)

"Micro Waves," by Mr. Hardy, Faculty, Cooper Union School of Engineering; October 28, 1952.

Films, "Naturally It's F.M." and "Electricity Serving New York," November 10, 1952.

University of Denver (IRE-AIEE)

"The Transistor, Successor to the Vacuum Tube?" by J. A. Doremus, Motorola Corporation; October 28, 1952.

"Microwave Transmission of Television Signals," by Dr. Strieby, American Telephone and Telegraph; November 17, 1952.

University of Detroit (IRE-AIEE)

"Problems in Automobile Engineering," by Ralph Schmuchal, Ford Motor Company; October 28, 1952.

Fenn College (IRE)

"Direct Current Amplifiers," by John Blaha, The Brush Development Company; October 29, 1952.

University of Florida (IRE-AIEE)

"New Equipment and New Design," by W. R. Saylor, General Radio Company; October 20, 1952.

George Washington University (IRE)

"Upper Atmospheric Research with Rockets," by Dr. H. E. Newill, Jr., Rocket Sonde Branch, Naval Research Laboratory; November 5, 1952.

Georgia Institute of Technology (IRE)

"Developments in the Power Field," by D. L. Chestnut, General Electric Company; October 21, 1952.

University of Illinois (IRE-AIEE)

"The Education of Electrical Engineers," by Dr. J. D. Ryder, Faculty, University of Illinois.

"Micro-Switches and Their Uses," by Walker Smith, Minneapolis Honeywell; November 12, 1952.

(Continued on page 90A)

23,698

HOURS of SERVICE

. . . and still no change in Performance Quality!

That's what Earl F. Lucas, Chief Engineer

WPAT

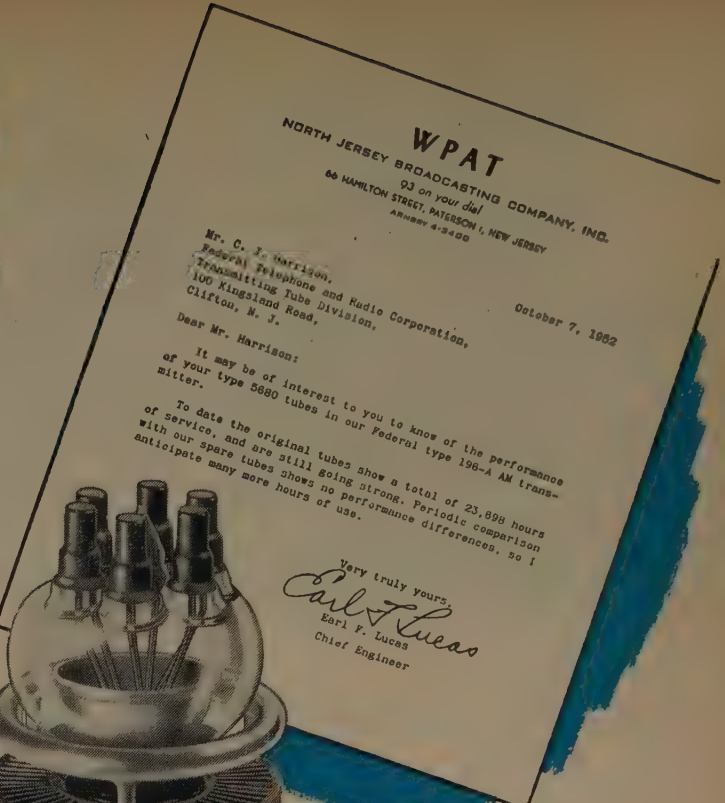
Paterson, N. J.

says about

Federal's

F-5680

2.5 KW POWER TRIODE



WPAT

NORTH JERSEY BROADCASTING COMPANY, INC.
93 on your dial
66 HAMILTON STREET, PATERSON 1, NEW JERSEY
ARMORY 4-3400

October 7, 1952

Mr. C. J. Harrison,
Federal Telephone and Radio Corporation,
Transmitting Tube Division,
100 Kingsland Road,
Clifton, N. J.

Dear Mr. Harrison:

It may be of interest to you to know of the performance of your type 5680 tubes in our Federal type 196-A AM transmitter.

To date the original tubes show a total of 23,698 hours of service, and are still going strong. Periodic comparison with our spare tubes shows no performance differences, so I anticipate many more hours of use.

Very truly yours,
Earl F Lucas
Earl F. Lucas
Chief Engineer

Here's another record of the long life and operating stability of Federal Tubes!

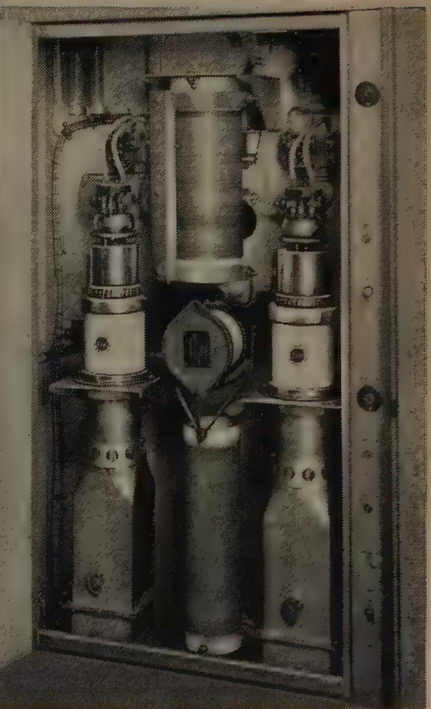
STILL on the job after 23,698 broadcast-hours! That's the record Federal's F-5680 has scored to date for WPAT, popular 5,000-watt station of the North Jersey Broadcasting Company, Inc.

Moreover, says Chief Engineer Lucas, "periodic comparison with our spare tubes shows no performance differences, so I anticipate many more hours of use."

Based on amazing service records of other Federal broadcast tubes, WPAT's F-5680 should be on the job *for years to come!*

Here's *proof* of the solid-rock ruggedness and dependable performance built into *all* Federal tubes by Federal craftsmen—drawing on tube design and production experience dating from the very birth of the industry . . . *on experience with hundreds of broadcasters!*

Get the facts of longer-life Federal tubes . . . write to Dept. K-837



Federal F-5680 Power Triodes— in WPAT's Federal 196-A AM Transmitter—providing one of the most powerful signals in the New York-New Jersey area.

"Federal always has made better tubes"

FEDERAL FTR TELEPHONE & RADIO

AN IT&T ASSOCIATE

Federal Telephone and Radio Corporation

VACUUM TUBE DIVISION

100 KINGSLAND ROAD, CLIFTON, NEW JERSEY

In Canada: Federal Electric Manufacturing Company, Ltd., Montreal, P. Q.
Export Distributors: International Standard Electric Corp., 67 Broad St., N. Y.

AUDIO ATTENUATORS

OVER 200 BASIC TYPES TO CHOOSE FROM

Do audio attenuator problems cost you money? Chances are Shallcross has a model to match your specifications exactly—and at moderate cost.

Shallcross attenuators are made in over 200 basic types. Each type can be supplied with a choice of attenuation characteristics . . . with a positive detent mechanism . . . and in numerous input and output impedances. Where calibration must be extremely accurate, Shallcross precision wire-wound resistors are used. For less critical applications, models with high grade composition resistors can be supplied—often at lower cost.

A complete description of all Shallcross attenuators — mountings, characteristics, and circuits is yours for the asking in Bulletin L-4A. SHALLCROSS MFG. CO., 524 Pusey Avenue, Collingdale, Penna.

QUICK DELIVERIES! Small quantities of popular 20 step Shallcross composition resistor potentiometers and wire-wound ladders without detents are immediately available.

Shallcross

STUDENT BRANCH MEETINGS

(Continued from page 88A)

Illinois Institute of Technology (IRE)

Films, "Standing Waves of Radio Transmission Lines" and "Propagation of Radio Signals" October 28, 1952.

"The Amateur and You," by Fred Quelle, Student, Illinois Institute of Technology; November 3, 1952.

University of Maine (IRE)

"Developments in the Curriculum in Electrical Engineering Since the Past Thirty Years," by Professor W. J. Creamer, Faculty, University of Maine; election of officers; October 16, 1952.

"Television Skyways," by Mansfield Packard, New England Telephone and Telegraph Company; November 13, 1952.

Massachusetts Institute of Technology (IRE-AIEE)

Business meeting; September 26, 1952.

"Servos," by D. P. Cambell, Faculty, Massachusetts Institute of Technology; October 28, 1952.

Business meeting; November 15, 1952.

University of Miami (IRE)

"Advantages of Membership in the IRE," by H. D. Randolph, Student, University of Miami; November 6, 1952.

Michigan College of Mining & Technology (IRE-AIEE)

General meeting; October 21, 1952.

"Summer Employment in England and Wales," by Andrew Itzov, Student, Michigan College of Mining and Technology; November 4, 1952.

Michigan State College (IRE-AIEE)

General meeting; October 15, 1952.

"Proposed Nationwide Telephone Dialing System," by Mr. Foulkrod, Bell Telephone Company; November 5, 1952.

University of Michigan (IRE-AIEE)

"Human Engineering—Key to Success," by M. J. Evans, The Melvin J. Evans Company; October 21, 1952.

"High Speed Electronic Computers," by R. E. Machol, Willow Run Research Center; November 12, 1952.

University of Minnesota (IRE-AIEE)

"The Electrical Engineering Curriculum and You," by Dr. H. E. Hartig, Faculty, University of Minnesota; October 22, 1952.

Mississippi State College (IRE)

"The Atom Speaks and Echoes the Word of God," by D. L. Chestnut, General Electric Company; November 10, 1952.

Missouri School of Mines & Metallurgy (IRE-AIEE)

Films, "Air Power is Peace Power" and "Propogation of Radio Waves"; business meeting; October 2, 1952.

Films, "Shining Rails" and "The Handling of Materials," October 9, 1952.

"Instrumentation and Control of Guided Missiles," by G. J. Fiedler, Sverdrup and Parcel, Inc., October 31, 1952.

"Suicide of a High Voltage Arc," by George Manke, Line Material Company; November 13, 1952.

University of Missouri (IRE-AIEE)

Slides and talk about Egypt by Professor Waldelich, Faculty, University of Missouri; September 30, 1952.

(Continued on page 93A)

STUDENT BRANCH MEETINGS

(Continued from page 90A)

"Induction Heating," by representatives of Allis-Chalmers; November 11, 1952.

University of Nebraska (IRE-AIEE)

General meeting and film, "Energy is Our Business," October 8, 1952.

General meeting and Talk, "Problems," by H. D. Sandborn, General Electric Recruiting Department; October 22, 1952.

The University of New Mexico (IRE)

General meeting; September 25, 1952.

"On Our Side of the Microphone," by Dr. R. E. Barton Allen, Faculty, University of New Mexico; October 24, 1952.

New Mexico College of Agriculture & Mechanic Arts (IRE-AIEE)

"Opportunities in Electrical Engineering," by G. R. Yelderman, Chairman of El Paso Section of AIEE; October 17, 1952.

College of the City of New York (IRE)

"Distribution Systems in New York City," by Mr. Buchanan, Consolidated Edison Company of New York; October 23, 1952.

"Ultra High Frequency Communication," by Mr. A. Kunze, Griffiss Air Force Base; October 30, 1952.

"Micro-Wave Techniques," by Dr. J. H. Vogelman, Rome Air Development Center; November 14, 1952.

New York University (IRE-AIEE) (EVE: DIV.)

"Growth of Power Industry—Its History and Future" by M. D. Hooven, Public Service Electric and Gas Company and C. S. Purnell, Westinghouse Corporation. Color movie, "Energy is our Business," November 14, 1952.

North Dakota Agricultural College (IRE-AIEE)

Films, "Impregnated Paper Insulated Cables" and "Laying another Submarine Power Cable" October 29, 1952.

Northeastern University (IRE-AIEE)

"The Starting-up and Testing of Hydrogen-cooled Turbine Generators," by W. J. Schell, Jr.; Westinghouse Electric Corporation; September 30, 1952.

"Magnetic Amplifiers," by S. Jackson, General Electric Company; October 9, 1952.

"Design and Application of Radar," by T. M. Bloomer, Westinghouse Electric Corporation; October 16, 1952.

"Northeastern University Graduate Division," by Dr. H. K. Brown, Faculty, Northeastern University; October 23, 1952.

Ohio State University (IRE-AIEE)

"Power Development in the Northwest," by T. M. C. Martin, Bonneville Power Administration; October 9, 1952.

Film, "Automobile Design"; October 23, 1952.

Field trip to the Columbus Sewage Treatment Works; November 6, 1952.

Oregon State College (IRE)

"Television and Television Networks," by Dr. M. E. Strieby, American Telephone and Telegraph Company; October 15, 1952.

"The Instrument Story," by Henry Berring, Weston Instrument Corporation; October 30, 1952.

University of Pittsburgh (IRE)

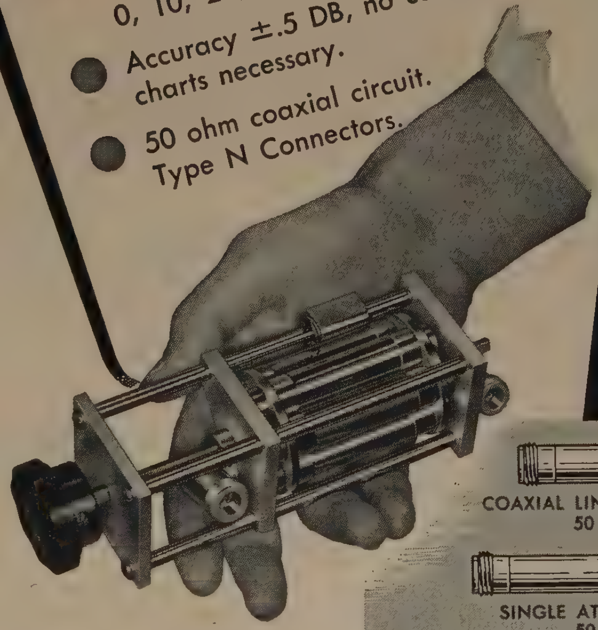
Business meeting; November 6, 1952.

General meeting; November 13, 1952.

(Continued on page 94A)

Precision
ATTENUATION to 3000 mc!

- VSWR less than 1.2 at all frequencies to **3000 mc.**
- **TURRET ATTENUATOR** featuring **"Pull - Turn - Push"** action with 0, 10, 20, 30, 40, 50 DB steps.
- Accuracy ±.5 DB, no correction charts necessary.
- 50 ohm coaxial circuit. Type N Connectors.



COAXIAL LINE TERMINATION
50 ohms

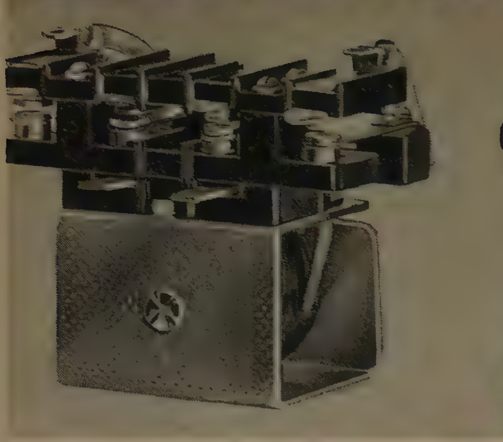
SINGLE ATTENUATOR PAD
50 ohms

VSWR ± 1.2 to 3000 mc.
One watt c.w. power dissipation

Inquiries are invited concerning single pads and turrets having other characteristics

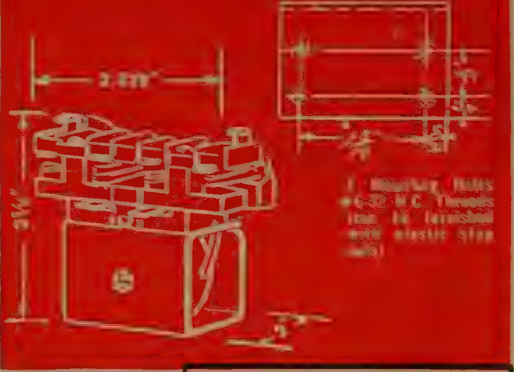
STODDART AIRCRAFT RADIO CO.
6644-C SANTA MONICA BLVD., HOLLYWOOD 38, CALIFORNIA
Hillside 9294

New Phil-trol Relay!



Sets a New High in Performance, Efficiency and Economy!

- WITHSTANDS VIBRATION AND SHOCK
- LONG OPERATING LIFE
- COMPACT, LIGHTWEIGHT, RUGGED
- 10 TO 20 AMPERE CAPACITY
- RESPONDS TO ½ CYCLE
- 1 TO 5 POLE, DOUBLE THROW



The new Phil-trol Type 33 Relay is another triumph of Phillips designing and engineering. It is an important addition to the complete line of Phil-trol Relays that enables you to select the type practically tailor-made for your particular needs.

The Type 33 Phil-trol Relay is of single coil design and box shape construction. Armature and frame construction of a type that affords fast action in both operation and release. Contacts are quickly and easily pressure adjusted by means of screws. The Type 33 is available for either a.c. or d.c. operation (33 AC or 33 QA). The constant of operate and release times has qualified this relay for many applications such as are found in timing circuits.

Write for detailed Data Sheet and copy of latest Phil-trol Relay Catalog

Phil-trol PRODUCTS

PHILLIPS CONTROL CORPORATION
84 W. JEFFERSON ST. • JOLIET, ILL.
OFFICES IN PRINCIPAL CITIES

STUDENT BRANCH MEETINGS

(Continued from page 93A)

RENSSELAER POLYTECHNIC INSTITUTE
(IRE-AIEE)

"Design and Characteristics of Power Transformer Cores," by Thomas Gordy, General Electric Company; October 28, 1952.

"R.P.I.'s Computer," by Dr. W. C. Stoker, Faculty, Rensselaer Polytechnic Institute; November 18, 1952.

RUTGERS UNIVERSITY (IRE-AIEE)

"Low Temperature Research," by Dr. B. Serin, Faculty, Rutgers University; October 23, 1952.

SAN DIEGO STATE COLLEGE (IRE)

"Servo-Mechanisms," by Dr. D. C. Kalbfell, Faculty, San Diego State College; October 28, 1952.

SEATTLE UNIVERSITY (IRE)

General business meeting; October 16, 1952.

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY (IRE)

Business meeting; October 23, 1952.

UNIVERSITY OF SOUTHERN CALIFORNIA
(IRE-AIEE)

Film, "More Power to America" and discussion on the General Electric Program of electrical expansion in industry, by Mr. W. Scott, General Electric Company; September 30, 1952.

Lecture and demonstration on television transmission, reception and existing cross-country networks, by Dr. Maurice E. Strieby, American Telephone and Telegraph Company; October 31, 1952.

STEVENS INSTITUTE OF TECHNOLOGY (IRE-AIEE)

"The Distributed Amplifier," by A. C. Gilmore, Faculty, Stevens Institute of Technology; November 12, 1952.

THE UNIVERSITY OF TEXAS (IRE-AIEE)

"The Engineer Must Learn to Talk with his Fellow Citizens," by Dr. H. H. Ransom, Faculty, University of Texas; October 20, 1952.

TEXAS AGRICULTURAL & MECHANICAL COLLEGE
(IRE-AIEE)

"Oceanography as Connected with Electrical Engineering," by D. F. Leipper, Faculty, Texas Agricultural and Mechanical College; November 4, 1952.

UNIVERSITY OF UTAH (IRE-AIEE)

"Engineering Aspects of Atomic Energy," by Dr. Lyle Borst, Faculty, University of Utah; October 30, 1952.

UTAH STATE AGRICULTURAL COLLEGE (IRE)

"The Instrument Story," by Henry Berring, Weston Electrical Instrument Corporation; October 14, 1952.

"The History of Engineering Mathematics," by Prof. Vance Tingey, Faculty, Utah State Agricultural College, October 29, 1952.

"An Engineering Career in Industry," by Prof. Melvin Greaves, Faculty, Utah State Agricultural College; November 12, 1952.

VILLANOVA COLLEGE (IRE-AIEE)

"The Electrical Engineer in a Large Electrical Industry," by C. T. Pearce, Westinghouse Electric Corporation; October 14, 1952.

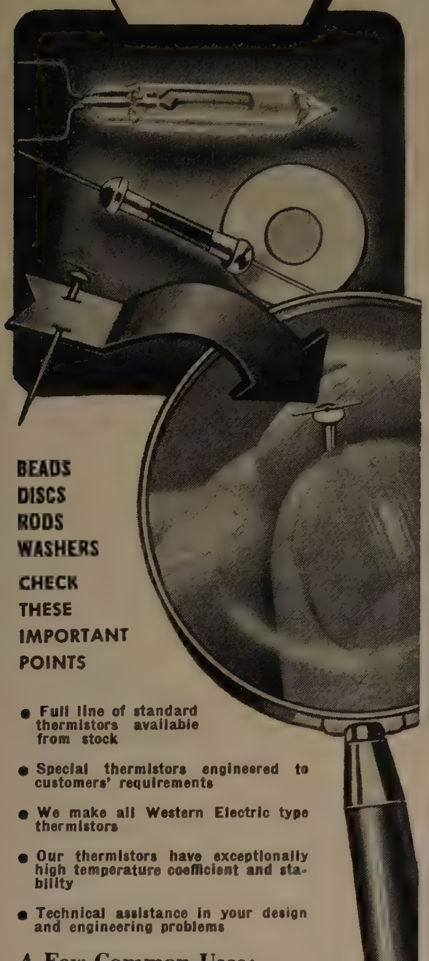
UNIVERSITY OF VIRGINIA (IRE-AIEE)

"The Roanoke Project," by L. Goeller, Student, University of Virginia and film, "The Shocking Truth"; October 21, 1952.

(Continued on page 96A)

VECO

VICTORY Thermistors



BEADS
DISCS
RODS
WASHERS

CHECK THESE IMPORTANT POINTS

- Full line of standard thermistors available from stock
- Special thermistors engineered to customers' requirements
- We make all Western Electric type thermistors
- Our thermistors have exceptionally high temperature coefficient and stability
- Technical assistance in your design and engineering problems

A Few Common Uses:

Time delay • Gas analysis • Volume limiting • Surge protection • Vacuum manometry • Flow measurement • Temperature control • Temperature measurement • Radar power measurement • Temperature compensation • Oscillator stabilization • and a host of new applications being developed every day.

Visit us at the IRE Show

Send for free literature.

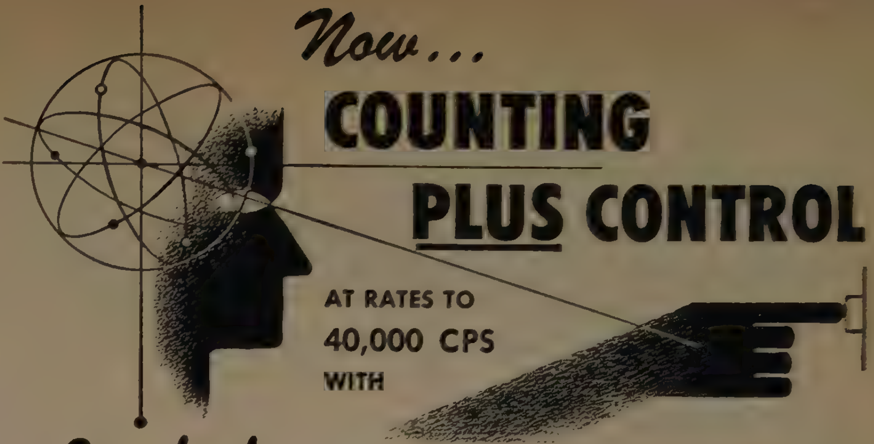
Victory
ENGINEERING CORPORATION
Springfield Road
UNION, NEW JERSEY

Telephone UNionville 2-7150

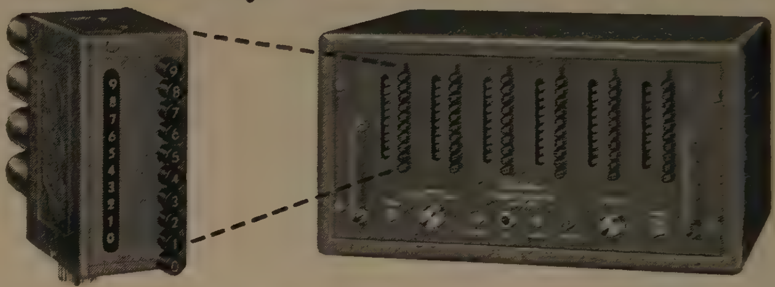
Now...

COUNTING PLUS CONTROL

AT RATES TO
40,000 CPS
WITH



Berkeley PRESET COUNTERS



DESCRIPTION—The Berkeley Preset Counter is an electronic decade with provisions for producing an output signal or pulse at any desired preset count within the unit's capacity. Any physical, electrical, mechanical or optical events that can be converted into changing voltages can be counted, at rates from 1 to 40,000 counts per second. Total count is displayed in direct-reading digital form. Presetting is accomplished by depressing pushbuttons corresponding to the desired digit in each column. Model 730 Preset Decimal Counting Units are used. These are completely interchangeable plug-in units designed for simplicity of maintenance and replacement.

APPLICATIONS—Flexibility and simplicity of operation make the Berkeley Preset Counter suitable for both production line and laboratory use. It has practical applications wherever signalling or control, based on occurrence of a predetermined number of events or increments of time is desired. Output signals from the unit can be used to actuate virtually any type of process control device, or to provide aural or visual signals.

SPECIFICATIONS	Model				
	422	423	424	425	426
MAX. COUNT CAPACITY	100	1000	10,000	100,000	1,000,000
INPUT SENSITIVITY (MIN.)	± 1 v. to ground, peak; at least 2 μ sec. wide				
OUTPUT	Choice of pos. pulse and relay closure, or pos. pulse. SPST relay closure approx. 1/30 sec; pulse output is + 125 v. with 3 μ sec. rise time and 15 μ sec. duration.				
PANEL DIMENSIONS	15⅝" x 8¾"		19" x 8¾"		
OVERALL DIMENSIONS	16⅝" x 10¼" x 13"		20¾" x 10½" x 15"		
POWER REQUIREMENTS	117 v. ± 10% @ 90w.		117 v. ± 10% @ 180 w.		
PRICE (F.O.B. FACTORY)	$375	$450	$595	$695	$795

M3

For complete information, please request Bulletin 201

Berkeley Scientific
division of BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVENUE • RICHMOND, CALIFORNIA

"DIRECT READING DIGITAL PRESENTATION OF INFORMATION"

POLYPENCO TEFLON*

available for economical fabrication

ROD	Extruded .187″ dia. to 2.0″ dia. Tolerance +.002″—.000″ up to 1″ dia. Molded 2.25″ dia. to 4.0″ dia. Beading .030″ to .187″ dia.
TUBING	Extruded .50″ to 2.0″ O.D. 3/16″ to 1.0″ I.D. min. wall ⅛″ Molded 1¼″ to 8″ O.D. at ¼″ intervals Wall thickness ⅜″—2¾″
OTHER SHAPES	Strip thickness .002″ to .060″ Slab thickness ⅛″ to 1½″ Special extruded shapes to customer specifications

Outstanding properties of TEFLON

Advantage	
WIDE SERVICE TEMPERATURE RANGE	−100°F to +500°F
CHEMICALLY INERT	Resists all known acids, alkalies and commercial solvents over the service temperature range.
ZERO WATER ABSORPTION	Water will not wet the surface.
LOW POWER FACTOR	.05% p.f. constant over entire frequency spectrum.
STABLE DIELECTRIC CONSTANT	2.0 unchanged over entire spectrum.
TOUGHNESS AT LOW TEMPERATURE	Izod impact strength −70°F 2 ft. lbs./in.

also available to your specifications

*Teflon is a trademark of the E. I. Dupont Co.

MACHINED PARTS • MOLDED PARTS

POLYPENCO / nylon teflon

Write for technical data and prices on Polypenco Teflon and Nylon

The POLYMER CORPORATION of Pennsylvania • Reading, Penna.

"Canadian Representative: C-H Engineering Company, Montreal, Quebec and Toronto, Ontario"

Student Branch Meetings

(Continued from page 94A)

VIRGINIA POLYTECHNIC INSTITUTE (IRE-AIEE)

"Expansion of Electrical Industry and Need for Engineers," by Mr. Parks, Westinghouse Electric Corporation, and film, "Energy is our Business"; October 21, 1952.

Discussion on Technical papers for coming year; October 28, 1952.

Business meeting; November 4, 1952.

UNIVERSITY OF WYOMING (IRE-AIEE)

"Why be a Member of the AIEE-IRE Joint Branch," by Robert Lawrence, Jr.; October 8, 1952.

Film, "Wyoming Resources," and general meeting; October 21, 1952.

Film, "Wyoming Resources," and general meeting; October 21, 1952.

"Stage Lighting," by Robert Lawrence and Gene Dymacek, Students University of Wyoming; November 4, 1952.

YALE UNIVERSITY (IRE-AIEE)

"The Philosophy and Instrumentation of Analog Computers," by R. D. McCoy, Reeves Instrument Corporation; October 16, 1952.

"History of Electrical Engineering at Yale," by A. G. Conrad, Yale University; October 22, 1952.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 51A)

Sound Effects Filter

A new Model 4200 sound effects filter which was designed for compactness (requires only 3½ inches of rack space) is available from **Hycor Co., Inc.,** 11423 Vanowen St., North Hollywood, Calif.

The unit features low hum pickup through the use of toroid coils. The unit may be used in circuits having signal levels as low as −40 dbm without the necessity for taking special precautions against hum pickup. The filter may be used at levels up to +20 dbm with negligible intermodulation distortion. All capacitors and inductors are hermetically sealed for lifetime service. Aging effects are negligible. Both low- and high-frequency cutoff controls cover 100, 250, 500, 1000, 2000, 3000, 4000, and 5000 cps. Attenuation is approximately 16 db, per octave on both high- and low-frequency cutoff points. Impedance is 500/600 ohms, in-out.

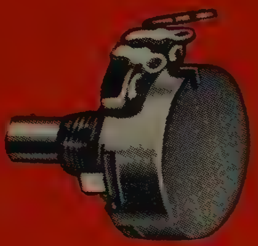
Net price fob North Hollywood is $195.00.

(Continued on page 110A)

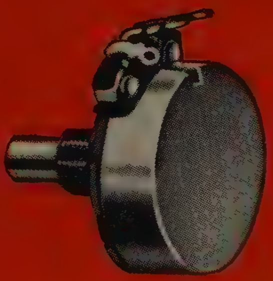
COMPLETE MILITARY LINE

***Immediate delivery* from stock on 189 types including JAN-R-94 and JAN-R-19 types of variable resistors.**

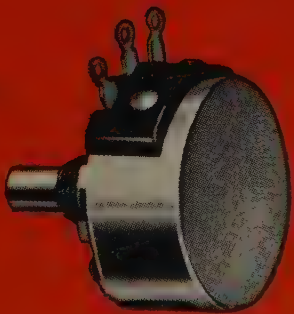
NEW 38-PAGE ILLUSTRATED CATALOG—
Describes Electrical and Mechanical characteristics, Special Features and Constructions of a complete line of variable resistors for military and civilian use. Includes dimensional drawings of each resistor. *Write today for your copy.*



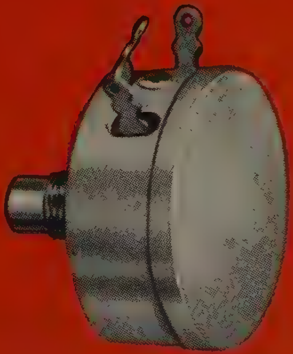
TYPE 45, (JAN-R-94, Type RV2)
1/4 watt, 15/16" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.



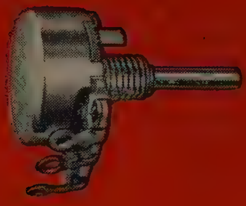
TYPE 35, (JAN-R-94, Type RV3)
1/2 watt, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.



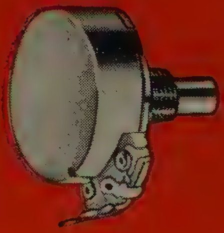
TYPE 252, (JAN-R-19, Type RA20)
2 watt, 1 17/64" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



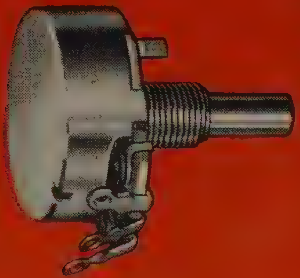
TYPE 25, (JAN-R-19, Type RA30)
(May also be used as Type RA25)
4 watt, 1 17/32" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



TYPE 65, (Miniaturized)
1/2 watt 70°C, 3/4" diameter miniaturized variable composition resistor.



TYPE 90
1 watt 70°C, 15/16" diameter variable composition resistor. Attached switch can be supplied. Also available in concentric shaft tandem construction.



TYPE 95, (JAN-R-94, Type RV4)
2 watt 70°C, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

See the complete CTS military and civilian lines of variable resistors at the

IRE SHOW

Grand Central Palace, New York City

MARCH 23-26, 1953

BOOTH 4-608

UNPRECEDENTED PERFORMANCE CHARACTERISTICS

Specially designed for military communications equipment subject to extreme temperature and humidity ranges. −55°C to +150°C...aridity to saturation.

CTS

CHICAGO TELEPHONE SUPPLY
Corporation

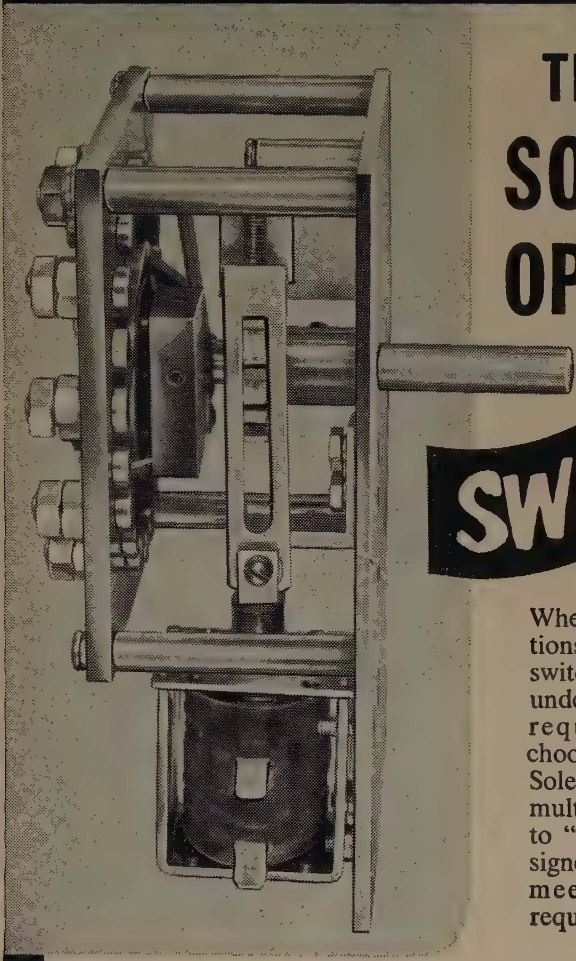
Precision Mass Production of Variable Resistors

Burton Browne Advertising

Ruggedly Designed for Dependable, Heavy-Duty Operation

TECH LABS
SOLENOID
OPERATED
SWITCHES

When operating conditions demand a solenoid switch that will stand up under the most rugged requirements, always choose Tech Laboratories Solenoid Switches. These multi-pole units are built to "take it" and are designed and produced to meet your individual requirements.



According to your specifications you can get:

- Remote push-button operation, with or without manual reset.
- Single or dual direction operation.
- Single, or up to 8 decks.
- Single pole to 4 poles per deck.
- Two contacts up to several hundred contacts per deck.
- Shorting or non-shorting.
- Ceramic or phenolic insulation.
- Load capacities up to 10 Amp.—120 Volts AC (depending on number of contacts).
- Long, trouble-free service life.

Information on these and our additional line of motor operated switches is yours for the asking . . . Write today for complete catalog.

TECH LABORATORIES, INC.
Manufacturers of Precision Electrical Resistance Instruments
PALISADES PARK, NEW JERSEY

MEMBERSHIP

The following transfers and admissions were approved to be effective as of January 1, 1953:

Transfer to Senior Member

Adler, R. B., Massachusetts Institute of Technology, Bldg. 20A—118, Cambridge 39, Mass.
Aronoff, M., 12 Doughty La., Fair Haven, N. J.
Beatty, R. W., Rm. 302, Radio Bldg., National Bureau of Standards, Washington 25, D. C.
Benoit, R. C., Jr., 109 Rose La., Rome, N. Y.
Bolljahn, J. T., 11 Tulip La., Palo Alto, Calif.
Bullington, K., 463 West St., New York 14, N. Y.
Clemens, C. S., Box 8, Belle Glade, Fla.
Corcoran, G. F., 7506 Hopkins Ave., College Park, Md.
Dillaplain, V. L., 203 S. Pine, Little Rock, Ark.
Flynn, F. J., 1917 Dalton Rd., Palos Verdes Estates, Calif.
Firestone, W. L., 368 Moraine Rd., Highland Park, Ill.
Goodman, D. H., 1508 Acton St., Berkeley 2, Calif.
Gracie, J. A., I.F.R.B., International Telecommunications Union, Palais-Wilson, Geneva, Switzerland
Hedberg, C. A., 2382 S. Fillmore St., Denver 10, Colo.
Higdon, R. V., 1030 S. Atherton, State College, Pa.
Hoadley, J. C., 2910 Collins Ave., Wheaton, Silver Springs, Md.
Honey, J. F., 304 Hedge Rd., Menlo Park, Calif.
Lax, C. B., Sgt. Jasper Apts., Charleston, S. C.
Maylott, C. F., 41 River St., Sidney, N. Y.
McKinley, H. W., 542 N.W. 34 St., Oklahoma City 3, Okla.
Merten, D. J. S., 166-56—23 Ave., Flushing, L. I., N. Y.
Ring, D. H., Box 7, Red Bank, N. J.
Rogers, A. J., 324 Roxbury Rd., Dayton 7, Ohio
Schram, S. M., Jr., 121 Forrer Blvd., Dayton 9, Ohio
Springer, P. W., 15 Virginia Ave., Dayton 10, Ohio
Thompson, J. M., Box 1245, Haselton Branch Post Office, Rome, N. Y.
Tieman, C. R., 4925—33 Rd., N., Arlington, Va.
Zaruba, E. J., 613 S. Yale Ave., Villa Park, Ill.

Admission to Senior Member

Bagley, G. D., 4800 Oak Grove Dr., Pasadena 3, Calif.
Carter, M. G., 516 Lewis St., Owensboro, Ky.
Clark, P. H., 1951 Adirondack Trail, Dayton 9, Ohio
Cookson, A. E., Federal Telecommunications Laboratories, Inc., 500 Washington Ave., Nutley 10, N. J.
Essigmann, M. W., Northeastern University, 360 Huntington Ave., Boston 15, Mass.
Fallon, G. P., 207 Witherspoon Rd., Baltimore 12, Md.
Hansen, T. A., 733 N. Washington St., Park Ridge, Ill.
Hessler, O. G., 12 Hiawatha Dr., Clarendon Hills, Ill.

Johnston, H. C., 21 N. American Blvd., Vandalia, Ohio
Leed, D., 609 W. 175 St., New York 33, N. Y.
Ludgate, F. E., Box 114, Rome Air Development Center, Griffiss Air Force Base, Rome, N. Y.
Randmer, J. A., 51 Strawberry Hill Ave., East Norwalk, Conn.
Reed, H. R., Electrical Engineering Department, University of Maryland, College Park, Md.
Reinnagel, R. E., 270 Crosby Blvd., Eggertsville, N. Y.
Roberson, R. E., 1100 N. Cerritos Dr., Fullerton, Calif.

(Continued on page 101A)

MEMBERSHIP

(*Continued from page 100A*)

Rose, L. H., Electrical Engineering Department, University of Dayton, Dayton 9, Ohio
Royston, M. F., 80 Innis Ave., Poughkeepsie, N. Y.
Schwerin, E. B., 710 W. 74 St., Kansas City, Mo.
Van Harlingen, W. M., Jr., Hqs., Signal Corps Engineering Laboratories, Fort Monmouth, N. J.

Transfer to Member

Ardelian, T. E., Hudsons Bay Co., Radio Laboratory, Brandon Ave., Winnipeg, Man., Canada
Aung, U. M., Assistant Engineer Wireless, H.Q. Telecoms., Rangoon, Burma
Babcock, W. E., 117 W. Magnolia Ave., Maywood, N. J.
Conn, R. B., 200 Anita Dr., Pasadena 2, Calif.
Danielson, F. H., Philco Tech. Rep., AA&GM, TAS, Box 72, Fort Bliss, Tex.
de Coligny, G., 11 rue E. Deschamps, Versailles, France
Fogel, L. J., 31 Spring St., Red Bank, N. J.
Franevsky, M., 1306 Jackson Rd., Gastonia, N. C,
Fritze, E. H., 313—31 St. Dr., S.E., Cedar Rapids, Iowa
Geiser, D. T., 2641 S. Fees, Wichita 10, Kans.
Grubb, D. L., 236 Paiko Dr., Honolulu 49, T. H.
Hyatt, W. R., Jr., Nike Contractor School, White Sands Proving Ground, Las Cruces, N. Mex.
Jaffe, L., 3467 E. 145 St., Cleveland 20, Ohio
Kamens, B. R., 511 Union Ave., Bridgeport, Conn.
Kampe, E. A., 409 Ramona Dr., El Paso, Tex.
Klein, W. J. J., 1206 Ruatan St., Silver Spring, Md.

(*Continued on page 102A*)

ZOPHAR
---WAXES
---COMPOUNDS

Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types; radio, television, etc. Cold flows from 100°F. to 285°F. Special waxes non-cracking at —76°F. Compounds meeting Government specifications plain or fungus resistant. Let us help you with your engineering problems.

ZOPHAR MILLS
107 YEARS

ZOPHAR MILLS, INC.
112-130 26th Street,
Brooklyn 32, N. Y.

HERE IS THE ANSWER TO YOUR PROBLEM OF

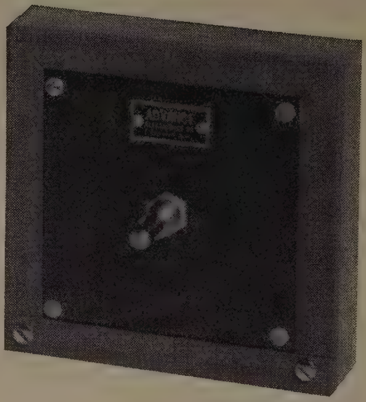
CONTINUOUSLY VARIABLE TIME DELAY!

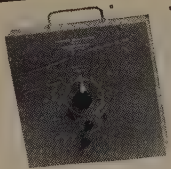
TYPE 506

TIME DELAY: Continuously variable from 0 to 0.275 microseconds
RISE TIME: $0.0005\sqrt{t}$, t is delay in microseconds
IMPEDANCE: 190 ohms nominal
SIZE: 1″ x 4″ x 4″. **WEIGHT:** 14 oz.

TYPE 507

TIME DELAY: Continuously variable from 0 to 0.8 microseconds
RISE TIME: $0.002\sqrt{t}$, t is delay in microseconds
IMPEDANCE: 390 ohms nominal
SIZE: 1″ x 4″ x 4″. **WEIGHT:** 14 oz.





TYPE 302 CONTINUOUSLY VARIABLE DELAY LINE
Advance also produces other continuously variable and step variable delay lines. The Type 302 distributed-parameter line offers the exclusive feature of continuously variable time delay from zero to 0.6 microseconds with excellent transient response.

STEP VARIABLE DELAY LINES

TYPE 601: Time delay in step of 0.2 microsecond up to 2.2 microseconds. Rise time is less than 0.1 microsecond in any step. Cutoff frequency is 6.5 mc. nominal.

TYPE 702: Time delay in step of 1 microsecond up to 10 microseconds. Rise time is less than 0.45 microsecond in any step. Cutoff frequency is 1.45 mc. nominal.

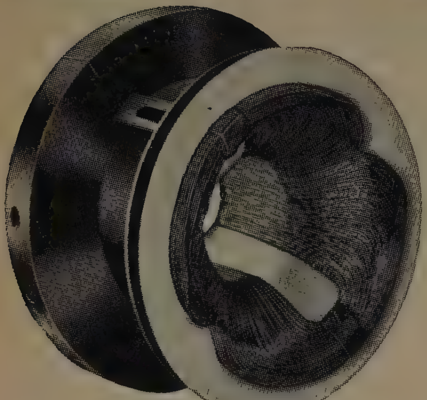
FIELD REPRESENTATIVES

H. L. Hoffman & Co., Boston, Mass.
Phone: Capitol 7-1905
J. R. Dannemiller, Cleveland, Ohio
Phone: Evergreen 1-5100
Arthur H. Lynch Associates, Fort Myers, Florida
Phone: Fort Myers 5-6762
Carl A. Stone Associates, Los Angeles 6, California
Phone: Republic 2-8105
Carl A. Stone Associates, San Francisco, California
Phone: Exbrook 2-4009
Kenneth E. Hughes, New York 23, N.Y.
Phone: Circle 5-8831
H. L. Hoffman & Co., Philadelphia, Pennsylvania
Phone: Pennypacker 5-9966
H. L. Hoffman & Co., Syracuse, New York
Phone: Syracuse 3-4645
Canada, Cossor (Canada) Ltd., Halifax, Nova Scotia
Phone: Halifax 4-6488

WRITE FOR DATA

ADVANCE ELECTRONICS CO.,
P. O. Box No. 394, Passaic, N. J.

DX Announces
a NEW 90° YOKE for 27" TUBES



It's Engineered for
TOP PERFORMANCE
... in Production NOW!

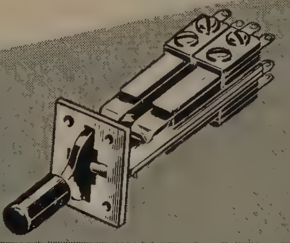
This new DX 90° Deflection Yoke has everything a television receiver manufacturer wants . . . a sharp full-screen focus, a minimum of pincushioning, the ultimate in compactness and a price that's downright attractive. Because this yoke has been brilliantly designed for mass production on DX's specialized equipment, it warrants immediate consideration in your 27" receiver plans. Write us today.

DEFLECTION YOKES . . . TOROID COILS . . . CRYSTALS
I. F. TRANSFORMERS . . . R. F. COILS . . . DISCRIMINATORS
SPEAKERS . . . TV TUNERS . . . ION TRAPS . . . TRANSFORMERS

DX COMPONENTS
"the heart of a good television receiver"
TRADE MARK

DX RADIO PRODUCTS CO.
GENERAL OFFICES: 2300 W. ARMITAGE AVE., CHICAGO 47, ILL.

SWITCHCRAFT* NEW TELEVER SWITCH



For Those Rugged Applications

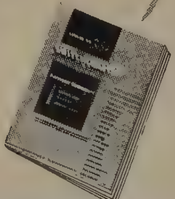
A unique design telephone type lever switch, rugged but light construction. For applications requiring dependable switching. Made in 2 and 3 position types, both locking and non-locking.

"LEV-R-SWITCH"
A smaller switch for single hole mounting. Available in many popular and less complex circuits.

MODIFICATIONS
Our flexible tools make modifications to meet special requirements economical and practical.

Write for catalog of standard switches and other components. For modifications please furnish complete information—applicable specifications, quantities, etc., for prompt handling of your inquiry.

This NEW CATALOG Should Be In Your File!



SWITCHCRAFT INC.
1332 N. Halsted St., Chicago 22, Ill.
Canadian Representative: Atlas Radio Corp. Ltd., 560 King St. W., Toronto 2B, Canada. Phone: Waverly 4761

* The name "Switchcraft" is a registered trade mark and is the property of Switchcraft, Inc.

AVAILABLE AT ALL LEADING RADIO PARTS JOBBERS

AVAILABLE AT ALL LEADING RADIO PARTS JOBBERS

MEMBERSHIP

(Continued from page 101A)

Koffer, M., 743 Hendrix St., Brooklyn 7, N. Y.
Kult, M. L., 1751 Tenth Ave., Sacramento, Calif.
Morrison, F., 3539 E. Pierce St., Phoenix, Ariz.
Passow, R. L., Box 263-K, R.F.D. 1, Bellefonte, Pa.
Peoples, J. F., 3708 N. Olney St., Indianapolis 18, Ind.
Reed, D. E., 2538 Brewster Ave., Redwood City, Calif.
Rose, R. H., II, 23 Fuller Ave., Chatham, N. J.
Rosenberg, J. D., 1610 Park Rd., N.W., Washington 10, D. C.
Schwartz, R. F., 744 N. 64 St., Philadelphia 31, Pa.
Shadle, P. W., 1895 Windsor Ave., Pasadena 3, Calif.
Slater, T. L., 3010 S. Monroe, Fort Wayne 5, Ind.
Sollars, R. C., 1171 W. 37 Pl., Los Angeles 7, Calif.
Swanson, R. E., 1777 Kipling St., Denver 15, Colo.
Swinney, R. W., 1128 N.W. 28 St., Oklahoma City, Okla.
Wachowski, H. M., 5472 N. Marmora Ave., Chicago 30, Ill.
Willardson, F. W., 220 E. Sixth St., Ext., Emporium, Pa.
Wilson, R. W., 282 Lakeshore Ave., Torontó, Ont., Canada

Admission to Member

Ahmad, K., Dy. Assistant Engineer, c/o Director General P & T, Ferere Rd., Karachi 3, Pakistan
Anderson, D., 663-B Couch St., Wright-Patterson AFB, Ohio
Bailey, R. T., 220 Edridge Way, Baltimore 28, Md.
Bigelow, H. L., Jr., 5913 Hersholt Ave., Bellflower, Calif.
Birdsey, G. J., Jr., 4224 McConnell Ave., El Paso, Tex.
Bower, F. H., 217 Seventh St., Fullerton, Pa.
Brewer, C. P., 582 E. Broadway St., Hawthorne, Calif.
Budd, W. H., Chicago Telephone Supply Corp., 1142–1232 W. Beardsley Ave., Elkhart, Ind.
Clinton, P. J., 108 W. 15 St., New York 11, N. Y.
Cochran, E. D., 510 N. Parish Pl., Burbank, Calif.
Coppock, R. A., 705 Arlington, N.W., Canton 8, Ohio
Davis, C. E., Box 8549, Wright-Patterson AFB, Dayton, Ohio
Fensler, W. E., 237 Waneta Ave., Dayton 4, Ohio
French, C. E., 6440 Mohawk La., El Paso, Tex.
Gammie, J., 10 Fernwood Rd., Summit, N. J.
Glazer, C. R., 89–19 Rutlegde Ave., Glendale 27, L. I., N. Y.
Harty, A. K. el, 14, Sheikh el Aghoury St., Kobba Gardens, Cairo, Egypt.
Heinke, C. B. R., Caixa Postal 2815, Sao Paulo, Brazil
Hollobaugh, R. C., Box 43A, McGregor Dr., R.F.D. 2, Verona, Pa.
Hudson, A. C., Radio & Electrical Engineering Division, National Research Council, Ottawa, Ontario, Canada
Irland, G. A., 5 Market St., Lewisburg, Pa.
Klise, K. W., Hq. Tactical Air Command, Langley Air Force Base, Va.
Lahana, P., Box 352, R.F.D. 2, Trumbull, Conn.
Langevin, R. A., c/o Brush Development Co., 3405 Perkins Ave., Cleveland 14, Ohio
Loebner, E. E., 336 Linden Ave., Buffalo 15, N. Y.
Lutener, O. C., 4907 Quitman St., El Paso, Tex.
MacGregor, H. D., 83 Freemont Ave., Toronto 15, Ont., Canada
McCarthy, F. J., Sylvania Electric Products, Inc., Electronics Division, North Woburn, Mass.
McCown, J. R., 3123 N.W. 47, Oklahoma City, Okla.

(Continued on page 104A)

GREATER RESOLUTION

SLOWER SWEEP RATE

PANADAPTOR SA-8a
PANALYZOR SB-8a

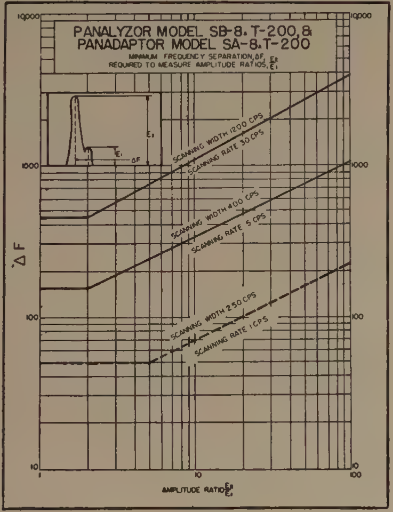
More Valuable Than Ever!

New Panoramic engineering achievements embodied in these improved instruments open important new applications involving modulation and interference problems.

SA-8a and SB-8a enable spectrum analysis of signals so close in frequency that their corresponding indications would normally mask one another.

- IMPROVED RESOLUTION down to 50 cps for RF spectrum analysis where maximum resolution is a "must"
- LOW SWEEP RATES down to 1 scan per second for analysis of pulsed RF signals with low p.r.f.'s
- LONG PERSISTENCE DISPLAYS
- CONTINUOUSLY VARIABLE SCANNING WIDTH

3 types available with maximum sweepwidths of 200 KC., 1 MC. and 10 MC.



WRITE TODAY FOR COMPLETE SPECIFICATIONS AND PRICES

PANORAMIC
RADIO PRODUCTS, INC.

12 SOUTH SECOND AVENUE, MOUNT VERNON, N.Y
MOunt Vernon, 4-3970

THE *Dependable* BALLANTINE MODEL 300

Famous for

SENSITIVITY

•

ACCURACY

•

STABILITY

PRICE $200.

VOLTAGE RANGE	**.001v to 100v**
FREQUENCY RANGE	**10 cps to 150 kc**
ACCURACY	**2% ENTIRE RANGE**
INPUT IMPEDANCE	**½ meg shunted by 30 uuf**

- Stability insured by the exclusive use of wire-wound resistors in the attenuator and feedback network.
- Same accuracy of reading at *ALL* points on the logarithmic voltage scale and linear decibel scale.
- Only ONE voltage scale to read with decade range switching.
- No "turn-over" discrepancy on unsymmetrical waves.
- Accessories available to extend the range to 20 uv and to 10 kv.
- Provides 70 DB amplifier flat within 1 DB from 10 cps to 150 kc.

Write for further details of this and other Ballantine voltmeters and accessories

BALLANTINE LABORATORIES, INC.
102 Fanny Road, Boonton, N.J.

Fine Wire for TRANSISTORS

In line with our specialization in wire for new applications, we produce wires of composition suitable for the manufacture of Transistors; including GALLIUM GOLD and ANTIMONY GOLD. These alloys have been made to fill a specific need arising from new developments in this field.

Other wires we make regularly for similar application are PHOSPHOR BRONZE, bare or electroplated, and PLATINUM Alloys produced to meet rigid specifications of tensile strength, size and straightness.

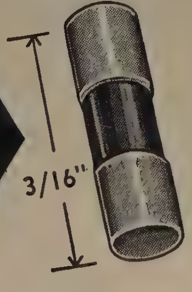
Write for Latest List of Products

SINCE 1901

SIGMUND COHN CORP. 121 So. Columbus Avenue • Mount Vernon, N.Y.

MICROWAVE RESISTORS
TELEWAVE TYPE R

SMALLEST RESISTOR AVAILABLE
(Ideal for Miniaturization)



TYPICAL APPLICATIONS
- Power measurement at any frequency
- Matched terminations for waveguides or coaxial lines
- Resistive power pickup loops
- RF pads or attenuators
- Dummy loads
- Temperature measurements
- Impedance matching

TYPE R RESISTORS employ noble metal film deposits on specially selected heat resistant glass.
FILM THICKNESS offers negligible skin effect, at microwave frequencies.
POWER CAPACITY of 1/4 watt provides high power handling ability.
PHYSICAL STRUCTURE is ideally suited to impedance matching in standard coaxial line and waveguides.
FINISH. Coated with a special silicone varnish to protect the film.

SPECIFICATIONS
Resistance: 50 ohms standard, other values on request.
Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 25°C
Size: 1/16 inch diam. x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 — 1/16 inch
Type R-093 — 3/32 inch
Temperature Coefficient: approx. 0.0019 ohms/ohm/°C.
Power Sensitivity: Approx. 10 ohms/watt

AVAILABLE FOR IMMEDIATE DELIVERY

TELEWAVE LABORATORIES, INC.
100 Metropolitan Ave. • Brooklyn 11, New York

MEMBERSHIP

(Continued from page 102A)

McKain, J. L., 105 E. Fourth, Emporium, Pa.
Mintz, E., 1614½ Veteran Ave., Los Angeles 24, Calif.
Myers, J. A., Jr., 770 N. Northwest Hwy., Park Ridge, Ill.
Naqvi, S. H., Y.M.C.A. Bldg., Y.M.C.A. Radio Institute, Lahore, Pakistan
Newton, W. P., Box 672, Alliance, Ohio
Noble, J. J., 7709 Beland Ave., Los Angeles 45, Calif.
Olsen, J. C., Box 214, BOQ, APO 323, c/o Postmaster, San Francisco, Calif.
Oxman, H. M., 49 Holworthy St., Roxbury, Mass
Payne, J. N., Box 254, Dahlgren, Va.
Powers, E. W., 7A Gov. Yeamans Apts., R.F.D. 9, Naval Base, S. C.
Rauf, A., Wireless Station Napier Barracks, Karachi, Pakistan
Revor, R. J., 11585 S. Prairie Ave., Chicago 28, Ill.
Richard S. J., 2810 Bailey Ave., New York 63, N. Y.
Schindler, M., 837 N. Kings Rd., Los Angeles 46, Calif.
Shintani, T., Radio NHK Uchisaiwaicho, Chiyodaku, Tokyo, Japan
von Arx, E. F., 68 Jerusalem Ave., Levittown, L. I., N. Y.
White, L. H., 3300 Mountain Ave., El Paso, Tex.
Yearsley, W. A. C. A., 31704 Broad Beach Rd., R.F.D. 2, Malibu, Calif.

The following elections to the Associate grade were approved to be effective as of December 1, 1952:

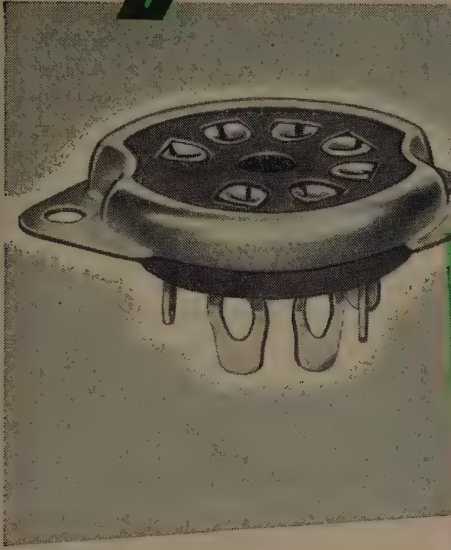
Amble, H. A., Jr., 1067 Mayflower, Lincoln Park 25, Mich.
Aronson, A. I., 219-A Garfield Ave., Collingswood, N. J.
Backman, K. E. H., 835 N. Massasoit Ave., Chicago, Ill.
Baker, C. W., 2479 S. Mountain Ave., Duarte, Calif.
Belless, J. J., Box 658, R.F.D. 7, Little Rock, Ark.
Barbour, R. E., 3804 Aldrich Ave., S., Minneapolis, Minn.
Beener, M. A., 380 Hillcrest, Wichita 8, Kans.
Beresford, H. E., Jr., 110 E. Reed Ave., Alexandria, Va.
Bloch, D. G., 39-61—44 St., Long Island City, L. I., N. Y.
Bloomquist, J. C., 1500 Black River Blvd., Apt. 21-A, Rome, N. Y.
Bourne, C. P., 4659 Pescadero, San Diego 7, Calif.
Bratschi, R. W., WSSCA, WSPG, Las Cruces, N. Mex.
Bray, J. I., Jr., Enderley Heights, R.F.D. 1, Buena Vista, Va.
Brown, J. O., 5239 S. California Ave., Chicago, Ill.
Bryan, J. S., 4807-8 Schuyler St., Philadelphia, Pa.
Buatte, L. A., Jr., 709 Walnut, Wamego, Kans.
Burns, J. H., R.F.D. 1, Germantown, Ohio
Carlson, D. G., 15131 Minnehaha St., San Fernando, Calif.
Carr, F. P., Jr., 3024 Wylie Ave., Baltimore 15, Md.
Chieffo, A. B., 86-30—208 St., Queens Village, L. I., N. Y.
Clark, W. J., 5903 Kensington Ave., Richmond 26, Va.
Cooney, S. M., Jr., 40 High St., Apt. 44, Springfield, Mass.
Cours, T. M., 36 Lyndale Ave., Buffalo 23, N. Y.
Cravotta, M., 157 Chestnut St., Everett 49, Mass.
De Muro, T. M., 565 Broadway, Hastings Terrace, Hastings-on-Hudson, N. Y.
Douthwaite, W., Jr., 28 Linden Ave., Rutledge, Pa.
Dowds, T. A., 5315 N. 13 St., Philadelphia 41, Pa.
Duepner, F., 2200 Olmos Dr., San Antonio 1, Tex.
Dunn, S. B., 105 DeWitt Pl., Ithaca, N. Y.
Eckles, W. W., Jr., 1791 Hazel, Beaumont, Tex.

(Continued on page 106A)

THE *complete answer* TO *uhf* SOCKET PROBLEMS—

"MYCALEX 410"

7- AND 9-PIN
UHF SOCKETS



MYCALEX engineers designed these sockets to provide a complete, yet economical, solution to UHF tube mounting problems. Exhaustive tests have proven their mechanical excellence and high electrical efficiency. The use of "MYCALEX 410" (injection molded glass-bonded mica) with its great dimensional stability permits a minimum amount of dielectric to be used in the body structure. This plus other unique design features results in extremely low inter-electrode capacitance. In addition to its other advantages—high arc resistance, high dielectric strength, non-porosity, etc., "MYCALEX 410" has very low dielectric loss at all frequencies including UHF and thereby offers great advantage over phenolic materials. "MYCALEX 410" operates continuously in temperatures up to 650°F with practically no change in electrical properties or mechanical structure. Soldering operations will not cause body distortion.

MYCALEX TUBE SOCKET CORPORATION
Under exclusive License of Mycalex Corporation of America • 30 ROCKEFELLER PLAZA, N. Y. 20

...ELECTRICALLY EFFICIENT!

...MECHANICALLY PERFECT!

- LOW INTER-ELECTRODE CAPACITANCE
- VERY LOW DIELECTRIC LOSS
- HIGH DIELECTRIC STRENGTH
- PERMANENT DIMENSIONAL STABILITY
- NON-HYGROSCOPIC, NON-WARPING

INFORMATIVE DATA SHEETS AVAILABLE!

Write for your complete set, together with loose-leaf binder for instant, easy reference. Your request will automatically assure prompt forwarding of all subsequent Mycalex data sheets and catalog material. Write on company letterhead please.

TROUBLE-FREE CONTACT TERMINALS!

Contact terminals on these sockets are so designed that the effective inductance from soldered connection to the tube base is no greater than if the connection was made directly to the tube pin. Special design results in high contact area pressure that effectively reduces contact resistance. Contact terminals are secured in the body in a manner that permits 90° bending of the tab without weakening.

ALL TYPES OF MOUNTING HARDWARE!

"MYCALEX 410" UHF Sockets, 7 or 9 pin, can be furnished mounted in various standard saddle hardware—regular saddles (top or bottom mounted), saddles with ground lugs, snap or JAN types, permitting the use of radio tube shields.

SINCE 1919
MYCALEX
THE INSULATOR

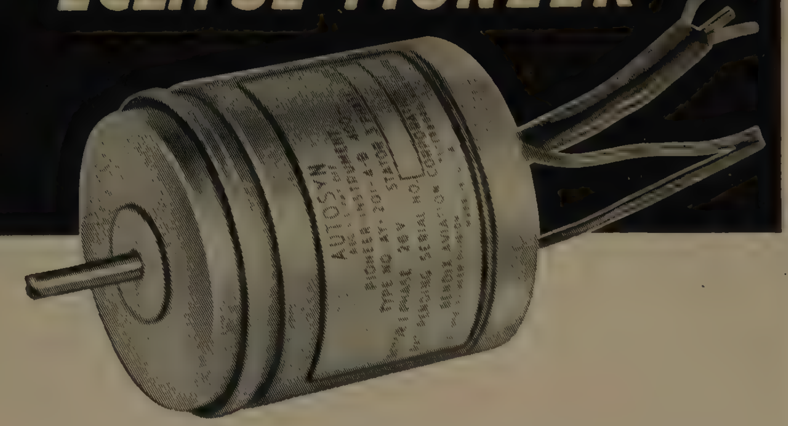
MYCALEX CORPORATION OF AMERICA
Owners of 'MYCALEX' Patents and Trade-Marks
Executive Offices: 30 ROCKEFELLER PLAZA, NEW YORK 20 • Plant & General Offices: CLIFTON, N. J.

Autosyn*

SYNCHROS

Precision-Built by

ECLIPSE-PIONEER



For more than 18 years, Eclipse-Pioneer has been a leader in the development and production of high precision synchros for use in automatic control circuits of aircraft, marine and other industrial applications. Today, thanks to this long experience and specialization, Eclipse-Pioneer has available a complete line of standard (1.431″ dia. X 1.631″ lg.) and Pygmy (0.937″ dia. X 1.278″ lg.) Autosyn synchros of unmatched precision. Furthermore, current production quantities and techniques have reduced cost to a new low. For either present or future requirements, it will pay you to investigate Eclipse-Pioneer high precision at the new low cost.

*REG. TRADE MARK BENDIX AVIATION CORPORATION

AVERAGE ELECTRICAL CHARACTERISTICS—AY-200 SERIES**

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes
Transmitters	AY201-1	26V, 400~, 1 ph.	225	1.25	25+j115	11.8	9.5	3.5	15
	AY201-4	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	20
Receivers	AY201-2	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	45
Control Transformers	AY201-3	From Trans. Autosyn	Dependent Upon Circuit Design				42.0	10.8	15
	AY201-5	From Trans. Autosyn	Dependent Upon Circuit Design				250.0	63.0	15
Resolvers	AY221-3	26V, 400~, 1 ph.	60	0.35	108+j425	11.8	53.0	12.5	20
	AY241-5	1V, 30~, 1 ph.	3.7	—	240+j130	0.34	239.0	180.0	40
Differentials	AY231-3	From Trans. Autosyn	Dependent Upon Circuit Design				14.0	10.8	20

**Also includes High Frequency Resolvers designed for use up to 100KC (AY251-24)

AY-500 (PYGMY) SERIES

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes
Transmitters	AY503-4	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	25.0	10.5	24
Receivers	AY503-2	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	23.0	10.5	90
Control Transformers	AY503-3	From Trans. Autosyn	Dependent Upon Circuit Design				170.0	45.0	24
	AY503-5	From Trans. Autosyn	Dependent Upon Circuit Design				550.0	188.0	30
Resolvers	AY523-3	26V, 400~, 1 ph.	45	0.5	290+j490	11.8	210.0	42.0	30
	AY543-5	26V, 400~, 1 ph.	9	0.1	900+j2200	11.8	560.0	165.0	30
Differentials	AY533-3	From Trans. Autosyn	Dependent Upon Circuit Design				45.0	93.0	30

For detailed information, write to Dept. G.

ECLIPSE-PIONEER DIVISION of Bendix AVIATION CORPORATION
TETERBORO, NEW JERSEY
Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

MEMBERSHIP

(Continued from page 104A)

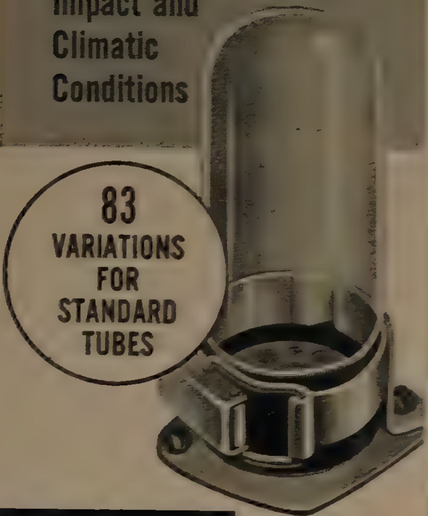
Ehret, J. R., 5335 N. Lakewood, Chicago 40, Ill.
Elefant, J., 486 E. 51 St., Brooklyn, N. Y.
Elmore, W. B., 299 W. 12 St., New York, N. Y.
Fauvre, R. F., 306 W. Juniper St., Oxnard, Calif.
Fields, G. S., 1250 Waterworks Rd., Newport, Ky.
Fisher, C. E., 525 Morey Dr., Menlo Park, Calif.
Fisher, S. G., 26 President, New Rochelle, N. Y.
Foster, G. C., 422 Claremont Ave., Kenmore 23, N. Y.
Fry, W. E., 406 W. 34 St., Kansas City 2, Mo.
Fussell, L. B., Box 454, Holloman, N. Mex.
Gallichotte, J. H., 12 Crawford St., Eatontown, N. J.
Galpin, W. H., 168 Sherbrook St., Winnipeg, Man., Canada
Gillen, D. A., 2079 Belle Ave., San Carlos, Calif.
Goldstein, B. S., U. S. Post Office, Haselton Branch, Rome, N. Y.
Goundry, R. A., 2740 Elmwood-Ave., Kenmore 17, N. Y.
Gribben, J. C., Jr., 103 N. Illinois St., Indianapolis 4, Ind.
Halchak, J. R., 10 True St., Everett, Mass.
Hamlett, J. G., 270 W. Brighton Ave., Syracuse, N. Y.
Harlan, R. E., 32 Freeman St., Roseland, N. J.
Hebel, E., Jr., 144-11—29 Ave., Flushing, L. I., N. Y.
Hedson, H. D., 2552 N. W. 20 St., Oklahoma City, Okla.
Heller, E. A., 905 N. Bend Rd. at Winton, Cincinnati 24, Ohio
Helmers, E. C., 331 Ludlow Ave., Cincinnati 20, Ohio
Higby, R. L., 3701—31 Ave., Long Island City, L. I., N. Y.
Hoffman, W. C., Code 530, U. S. Navy Electronics Laboratory, San Diego 52, Calif.
Hogan, D. L., 12512 Epping Ct., Silver Springs, Md.
Hogsed, H. B., 1201 East Ave., Akron 7, Ohio
Holcomb, D. R., 2418 W. Wilkes, Biloxi, Miss.
How, F. B., 1800 Prairie Ave., Glenview, Ill.
Humphrey, H. A., 608 Oak St., Newport, Ky.
Humphreys, T. G., Jr., 410 S. Tenth St., Birmingham 3, Ala.
Iyer, S. K., Indian Radio & Television College, 157 Lloyds Rd., Madras, India
Jakub, J. J., 610 Magnolia Ave., Elizabeth 4, N. J.
Jerrell, J. H., 1916 Windsor Rd., Dayton, Ohio
Katzenberger, H. S., 5201 Blanco St., Apt. B, El Paso, Tex.
Keetch, W. A., 429 Colonial Rd., Ridgewood, N. J.
Kemmerly, J. E., 242 Pioneer Village, Denver 10, Colo.
Kessler, J. O., Fairview Ave., R.F.D. 3, Princeton, N. J.
Kettler, R. F., Jr., 7313 Oak Park Ave., Van Nuys, Calif.
Kiesling, P. W., Jr., 65 Park Dr., Apt. 22, Boston 15, Mass.
King, G. W., 63 Hillside Ave., Pleasantville, N. Y.
Kirschner, A. G., 1146 Nancy Lee La., Cincinnati 38, Ohio
Klein, A. L., Walther-Boland Association, 301 Broadway, San Francisco, Calif.
Kohler, E., 43 Doherty Dr., S., Clifton, N. J.
Kortright, F. U., 4628 N. Dover St., Chicago 40, Ill.
Krinsky, B. D., 18 Columbia Pk., Haverhill, Mass.
Langille, N. A., Jr., 130—75 St., Brooklyn 9, N. Y.
Lawrence, D. H., International Business Machines Corp., 230 S. 15 St., Philadelphia, Pa.
Lawrence, R. E., 812 Eighth Pl., China Lake, Calif.
Leahy, F. N., 4209 Allerton Blvd., Fort Wayne, Ind.
Lerman, H., 1460 Clay Ave., New York 57, N. Y.
Levonian, P. V., Moore School of Electrical Engineering, University of Pennsylvania, Philadelphia, Pa.

(Continued on page 108A)

BIRTCHER

TUBE CLAMPS

Hold Tubes in Sockets under all Vibration, Impact and Climatic Conditions



You can't shake, pull or rotate a tube out of place when it's secured by a Birtcher Tube Clamp. The tube is there to stay. Made of Stainless Steel, the Birtcher Tube Clamp is impervious to wear and weather.

BIRTCHER TUBE CLAMPS can be used in the most confined spaces of any compact electronic device. Added stray capacity is kept at a minimum. Weight of tube clamp is negligible.

Millions of Birtcher Tube Clamps are in use in all parts of the world. They're recommended for all types of tubes: glass or metal—chassis or sub-chassis mounted.

THERE'S A BIRTCHER TUBE CLAMP FOR EVERY STANDARD AND MINIATURE TUBE!

Write for samples, catalogue and price lists.

THE BIRTCHER CORPORATION
4371 Valley Blvd.
Los Angeles 32, Calif.

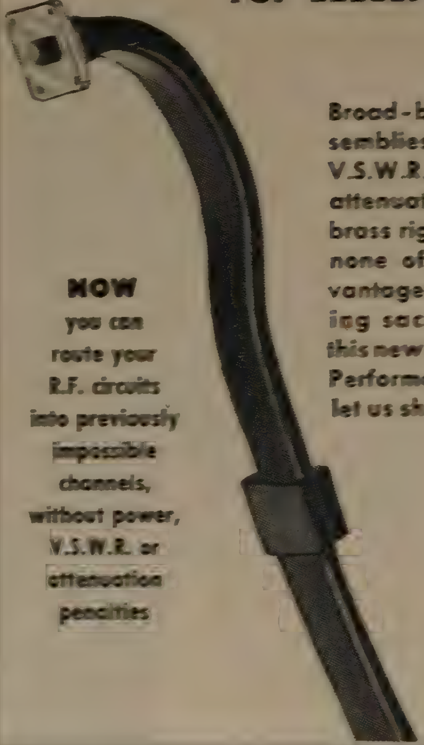
For the first time

FLEXIBLE WAVEGUIDE *with power rating equal to that of rigid guide!*

BANK ON **Airtron** inc. for

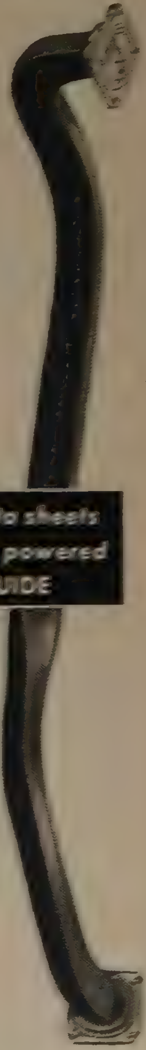
HIGH POWERED FLEXAGUIDE®

for RADAR applications

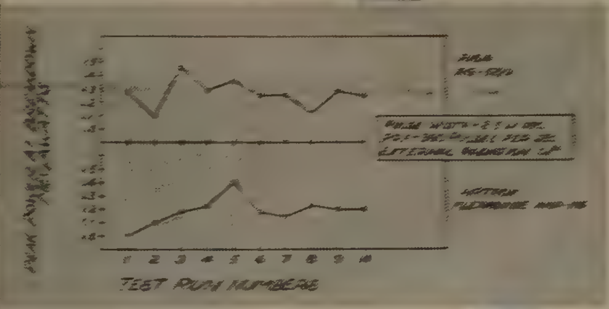


NOW you can route your R.F. circuits into previously impossible channels, without power, V.S.W.R. or attenuation penalties

Broad-band FLEXIBLE assemblies guaranteed to a V.S.W.R. of less than 1.10—attenuation equal to that of brass rigid waveguide—yet none of the essential advantages of flexible plumbing sacrificed to achieve this new type of waveguide! Performance is what counts; let us show you . . .



Write for data sheets on new, high powered FLEXAGUIDE



Airtron inc.
20 East Elizabeth Ave., Linden, New Jersey

BRANCH OFFICES
CHICAGO ST. LOUIS DAYTON DALLAS
BALTIMORE LOS ANGELES SEATTLE

A Precision Scope
...that can GO PLACES

THE TYPE 315-D

How often have you wished for a precision oscilloscope that you could easily take on long trips and into tight spots? The TEKTRONIX Type 315-D is that kind of instrument—weighs only 36 lbs., measures only 12⅜″ high, 8⅝″ wide, 18¼″ deep. Designed for portability, it works on power supply frequencies from 50 to 800 cycles. And it has all the features you expect in a fine laboratory oscilloscope . . . plus several new features never before commercially available.

Time base range . . 1 μsec to 50 sec
Sensitivity . . . . .0.01 v/division ac
(double the originally published sensitivity)
Vertical bandwidth . . . .dc to 5 mc
Risetime . . . . .0.07 μsec

Sensitivity — 12 Calibrated Ranges
ac only—0.01, 0.02, 0.05 v/division 5 cycles to 5 mc
dc and ac—0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 v/division dc to 5 mc

Signal Delay—0.25 μsec

Time Base — 24 Calibrated Ranges —3 per decade, 0.1 μsec/division to 5 sec/division. 100 second sweep available but not calibrated

Graticule — Edge lighted, marked in ¼″ divisions

5X Magnifier — Expands time base to right and left of center

Direct coupled unblanking

Trigger amplitude discriminator

Flat-faced high-definition 3″ CRT

Square wave voltage calibrator

Sawtooth and + Gate available at front panel

TEKTRONIX Type 315-D—$785 f.o.b. Portland, Ore.
Call or write your TEKTRONIX Field Engineer for demonstration of the Type 315-D.

TEKTRONIX, Inc.
P. O. Box 831B, Portland 7, Oregon
Cable: TEKTRONIX

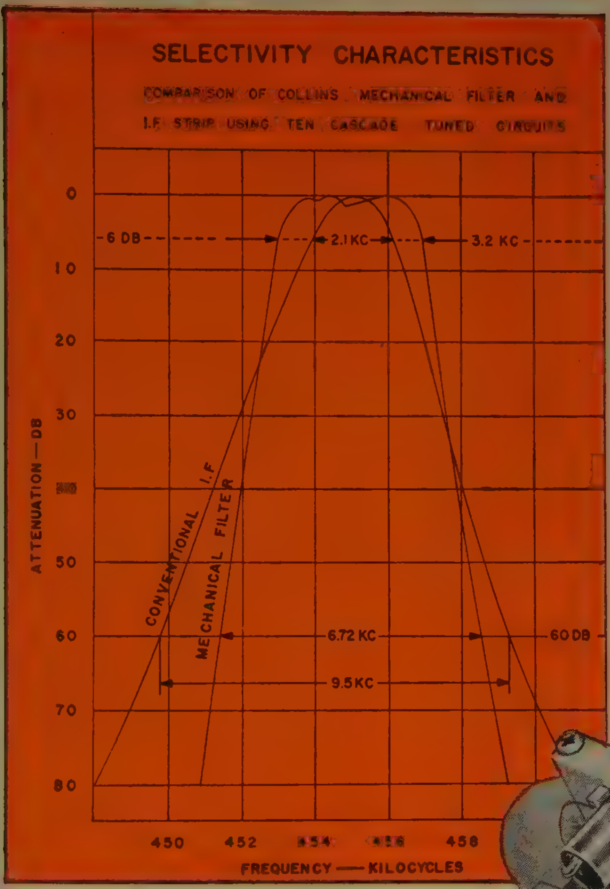
MEMBERSHIP

(Continued from page 106A)

Lewis, M. C., 59 Lanark Rd., Brookline 46, Mass.
Lowy, W. M., 16 Walnut Ave., Washington, D. C.
MacDonald, C. F., 182 Duchess Ave., London, Ont., Canada
Macht, L. E., 40—18 St., Newport, Ky.
Magnuson, V. P., 15225 S. Wilton Pl., Gardena, Calif.
Martin, R. C., 106 Fairway Dr., Huntsville, Ala.
Mathis, G. P., 1360 A 43 St., Los Alamos, N. Mex.
McAllister, M. J., 406 W. 34 St., Kansas City, Mo.
McClanathan, G. L., 509 E. San Juan Cove, Phoenix, Ariz.
McCullough, J. H., 71 Sheep La., Levittown, L. I., N. Y.
McDowell, M. H., Box 245, Red Lion, Pa.
McPheeters, D. W., 45 Howard Ave., Binghamton, N. Y.
Mehta, G. K., Spectroscopic Laboratories, Institute of Science, Mayo Road, Bombay, India
Metzger, H. W., 335 Carvol Ave., Covina, Calif.
Middleton, A. E., Battelle Memorial Institute, 505 King Ave., Columbus, Ohio
Mills, W. B., 26 Willow St., Newton Center, Mass.
Moffat, D., 2474 Hull Ave., North Bellmore, L. I., N. Y.
Moore, R. L., 51 Ledge Rd., Lynnfield, Mass.
Morrow, R. A., Apt. 15-D, Lowry Ct., Richfield Village Apts., Clifton, N. J.
Mullen, E. B., General Electric Co., Electronic Laboratory, Rm. 300, Electronics Park, Syracuse, N. Y.
Murray, W. A., 7541 Taxco Rd., El Paso, Tex.
Myers, R. P., 3700 E. Third St., Dayton 3, Ohio
Nelson, K. L., 1216 Fremont, Apt. 4, South Pasadena, Calif.
Neu, W., Hofweisenstrasse 35, Zurich, Switzerland
Newman, E. L., 425 Ridge Rd., Apt. 8-A, North Arlington, N. J.
Nistal, G. E., 5910 Greene St., Philadelphia, Pa.
Norris, W. J., 3894 Robina Ave., Berkley, Mich.
O'Bryhim, D. H., 1547 Ala Wai Blvd., Honolulu, T. H.
Ostheimer, F. R., Rm. 2311, 29 Broadway, New York, N. Y.
Pantazin, T., 217 Esmond, Fort Wayne, Ind.
Partridge, E. M., Jr., 104 Harding Rd., Wyckoff, N. J.
Patterson, J. L., 1220 Burlington Ter., Des Moines 14, Iowa
Perrault, R. E., 11948 Magnolia Blvd., North Hollywood, Calif.
Pike, F., Jr., R.F.D. 1, Somerville, Ohio
Pitalis, P. H., 9632 S. Chappel, Chicago 17, Ill.
Podell, E. J., 3736 Garfield Ave., Pennsauken, N. J.
Price, E. L., 5309 W. 123 Pl., Hawthorne, Calif.
Prudhom, A. L., 115-43—237 St., Elmont, L. I., N. Y.
Pscheidt, K., 8675 Champagneur Ave., Montreal 15, Que., Canada
Puterbaugh, W. H., 121 Martha Ave., Centerville, Ohio
Raible, R. W., Box 675, Fayetteville, Ark.
Rath, H. B., Box 116, Park Ave., Elsmere, Ky.
Reed, J. E., Box 274, R.F.D. 2, Loveland, Ohio
Remorenko, M. S., 109 E. Roland Rd., Chester, Pa.
Rice, K. J., 1919 Emerson Ave., Dayton 6, Ohio
Riggins, H. C., 775 Calderwood La., Pasadena, Calif.
Rinker, E. A., 1845 Grant St., Apt. 6, Denver, Colo.
Rizwi, W. A., A.D.E.T. c/o D.C., Posts & Telegraphs, Karachi 3, Pakistan
Rock, A. J., 227 Los Trancos Woods Rd., Woodside, Calif.
Rockwood, C. C., 6040 S. Greenwood Ave., Chicago 37, Ill.
Rouse, R. J., Jr., 2689 N. Bend Rd., Cincinnati 24, Ohio
Ruddock, W. F., Pitney-Bowes, Walnut & Pacific Sts., Stamford, Conn.

(Continued on page 110A)

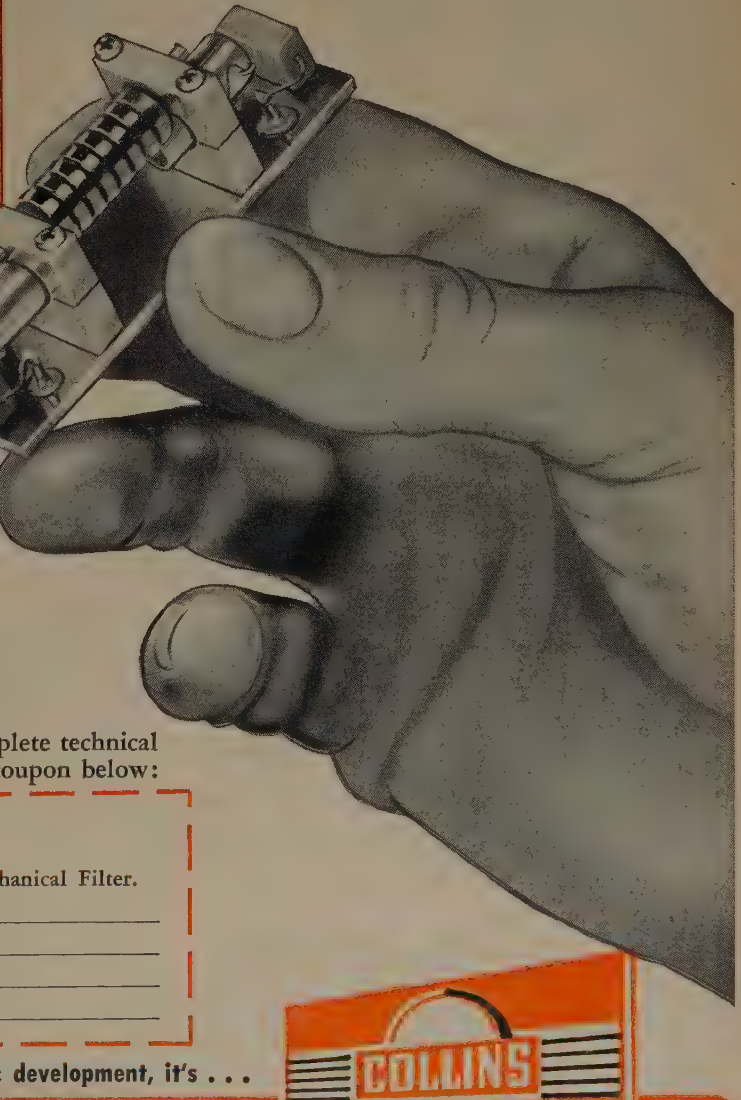
The *NEW* Collins Mechanical Filter . . .


SELECTIVITY CHARACTERISTICS

COMPARISON OF COLLINS MECHANICAL FILTER AND I.F. STRIP USING TEN CASCADE TUNED CIRCUITS

ANOTHER outstanding result of Collins Research and Development — the Mechanical Filter — has been engineered to fill a long-standing need in the field of electronics for a compact, permanently tuned band pass filter for intermediate frequency amplifier applications. Mechanical elements of the Collins Filter provide selectivity characteristics approximating the ideal rectangular shape needed for very close spacing of adjacent voice communication channels. Space requirements are reduced to a minimum with this hermetically sealed component that *requires no adjustment.*

Production of the Collins Mechanical Filter in quantity is going ahead at an increased rate in anticipation of the many applications in industry for which this NEW Filter will be found ideally suited. Characteristics of Filters in current production are shown in the specifications below. Filters having other characteristics are in development and will be announced in the future.



SPECIFICATIONS

Operating Frequency	455 kc
Nominal Band Width	3 kc
Peak to Valley Ratio	1.5 db
Insertion Loss	26 db
Overload Input Power Level	.035 watt
Operating Temperature Range (without temperature compensation)	15°C to 80°C
Vibration	Satisfies Requirements of Army Navy Specification AN-E-19
Case Size	1" x 15/16" x 2-13/16"
(Filter Shown with Hermetically Sealed Shield Removed)	
Input and Output Impedance	6,500 ohms

Engineering samples are now available. For complete technical data and price information, use the convenient coupon below:

Collins Radio Company **(Dept. 23)**
Cedar Rapids, Iowa

Please send complete Information on The Collins Mechanical Filter.

NAME____________________

TITLE____________________

ADDRESS OR FIRM____________________

CITY__________ STATE__________

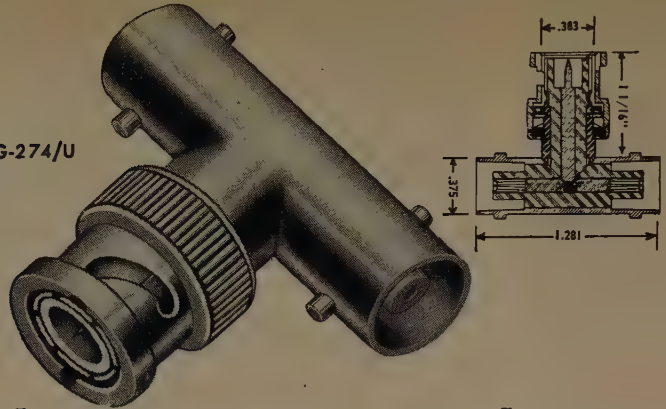
For advanced electronic development, it's . . . COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 W. 42nd Street, NEW YORK 36 **1930 Hi-Line Drive, DALLAS 2** **2700 W. Olive Avenue, BURBANK**

QUALITY • QUANTITY • *QUICKLY*

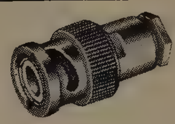
Type BNC UG-274/U



The Right Connection . . . right now!

Dage RF connectors are designed *right*, engineered *right*, built *right*—and available *now*. Each part is carefully made—Dage connectors are precision assembled to assure a sure connection.

Check your specifications—be sure you're *right*—ask for Dage radio frequency connectors.



Type BNC UG-88/U

ALWAYS SPECIFY

DAGE

Dage is versatile . . . any standard or special RF connector can be quickly produced at Dage. Write for Catalog 101.

RADIO FREQUENCY CONNECTORS

DAGE ELECTRIC COMPANY, INC., 67 NORTH SECOND STREET, BEECH GROVE, IND.

NRK

Now in our new home

N.R.K. MFG. & ENGINEERING CO.
4601 West Addison Street
CHICAGO 41, ILLINOIS
New telephone: SPring 7-2970

Microwave Assemblies, Radar Components and Precision Instruments . . . manufactured to your Blueprints and Specifications.

MEMBERSHIP

(Continued from page 108A)

Sachs, J., Radio Station KVRH, Salida, Colo.
Shafer, M. W., 1213 Guildford Rd., Glen Burnie, Md.
Shannon, B. F., Manteo, N. C.
Shannon, H. H., 303 Eighth Ave., Asbury Park, N. J.
Sheffield, R., 23 Hawthorne Dr., Atherton, Calif.
Smith, S. L., 938 Van Auken Cir., Palo Alto, Calif.
Smith, W. R., 4532 Willow Brook Ave., Hollywood, Calif.
Sonnanstine, E. H., Jr., Box 269-P, R.F.D. 11, Dayton, Ohio
Sorensen, G. L., 1819 Ingleside Ter., N.W., Washington 10, D. C.
Spann, R. G., 187 N. Fulton Ave., Mount Vernon, N. Y.
Spencer, G. M., 55 Guay Ave., St. Vital, Man., Canada
Spradlin, K. M., 4201 S.W. Anthony Wayne Dr., Fort Wayne, Ind.
Staab, P. C., 388 Glen Oaks Rd., Cincinnati 38, Ohio
Stein, E. F., 403 Yale Ave., Baltimore 29, Md.
Steinhardt, L., 152-14 Melbourne Ave., Kew Gardens, L. I., N. Y.
Steube, F. R., Corrientes 330, Buenos Aires, Argentina
Stevens, R. T., 48 Laconia St., Lexington 73, Mass.
Stewart, J. H., 120 S. Jackson, Belleville, Ill.
Stillwell, T. E., River St., R.F.D. 1, North Billerica, Mass.
Szego, J. L., Mackay Radio, 67 Broad St., New York 4, N. Y.
Teno, E., Lycoming College, Williamsport, Pa.
Thiemaens, A. A., 655 McIlvaine, San Antonio, Tex.
Toman, K., Harvard University, Cruft Laboratory, Cambridge, Mass.
Townsend, G. R., 44 Lakeside St., Springfield 9, Mass.
Underwood, W. B., Box 345, Victoria, Va.
Weisenburger, F. M., 3057 Kilbourn Ave., Chicago 41, Ill.
Welch, K. A., 2932 Grant Ave., El Paso, Tex.
Whitehill, H. J., Jr., Coleman Instrument Co., 706–724 S. Troost, Tulsa, Okla.
Whitley, E. G., 160 Gordonhurst Ave., Upper Montclair, N. J.
Williams, S. A., 750 Fleet Ave., Winnipeg, Man., Canada
Winitzer, A. J., 16 Short St., Brookline, Mass.
Wong, J. L., 1116 Pacific Ave., San Francisco, Calif.
Wood, R. A., 1621 Floribunda Rd., Burlingame, Calif.
Yount, R. G., Box 816, Wickenburg, Ariz.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 96A)

New Literature

The release of a new cross-referenced transformer catalog (number T-100) has been announced by **Utah Radio Products Co., Inc.,** Huntington, Ind.

This catalog automatically matches any Utah transformer to the manufacturer's part. Reference charts are supplemented by electrical and physical data for each item together with tube applications for output transformers.

Copies may be obtained from any Utah sales representative or from the factory.

(Continued on page 111A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 110A)

Electrical Insulating Tape

A new, self-bonding electrical insulating tape, designed as Bi-Seal Type V, has been announced by the **Bishop Manufacturing Corp.**, 86 Factory St., Cedar Grove, N. J.

This tape has all the characteristics of the original Bi-Seal patented tape, but with greatly increased abrasion and resistance, tensile, and dielectric strength (over 1,000 volts per mil). It is suited to wire and cable splicing, as it affords such advantages as: water, acid, alkali, corrosion and weather-proofness. It is impervious to ozone and oxygen.

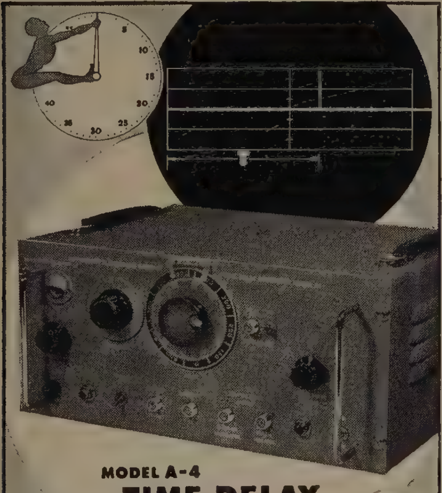
Type V is a self-bonding, polyethylene based compound that fuses into a solid homogeneous mass when applied. It does not depend on an adhesive for bonding.

Bi-Seal Type V can be applied at −40° F and does not become brittle at sub-zero temperatures.

Type V is UL approved as a splice insulation for rubber and thermo-plastic insulated wires and cables when temperatures do not exceed 80°C, and when covered with friction tape.

Type V is available in standard widths of ½ inch, ¾ inch, and 1 inch, .020 inch thick, in 30 foot rolls, Clear or Black.

(Continued on page 112A)



MODEL A-4
TIME DELAY GENERATOR

- A precision device for the generation of accurate and variable time intervals from .00001 to 10 seconds.

Also available:
Model A-2—.8 to 100,000 μs.

Write for complete data:
Our bulletins I-A-4 and I-A-2

Rutherford
ELECTRONICS CO.
3707 S. ROBERTSON BLVD., CULVER CITY, CALIF.

Attention! . . . ELECTRONIC DEVELOPMENT ENGINEERS

Reduce your problems with the
NEW EUREKA "SNAPPER"

THERMAL TIME DELAY RELAY

Features . . . Snap action. Single Pole Double Throw. Lightweight. Low operating temperature. Operates in any position. High contact rating. Gas filled. Low heater current. Durability and long life.

EUREKA'S "SNAPPER"

VOLTAGE: 6.3, 26.5
115 volts (A.C. or D.C.)
or as required
AMBIENT TEMPERATURE RANGE:
−60°C. to + 80°C.
ENVELOPE: Miniature,
or octal metal.
TIME DELAY PERIODS:
Preset from 5 seconds up.
VACUUM: Evacuated, inert
gas filled.
HEIGHT: 1¾" maximum seated.

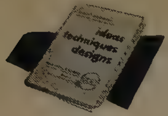
EUREKA PRESENTS **POSITIVE**
SNAP ACTION

The ELIMINATION OF CHATTERING is accomplished with the incorporation of "POSITIVE SNAP ACTION" in the EUREKA "SNAPPER" . . . LEADING ELECTRONIC MANUFACTURERS have acknowledged the new EUREKA "SNAPPER" as a major advancement in this field, and have already accepted this relay as a standard component of their latest equipment.

Inquiries are invited . . . send for our "Bulletin Number Snapper"

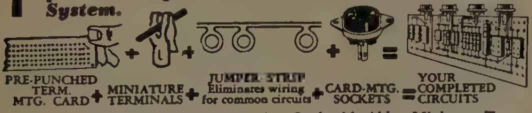
EUREKA TELEVISION AND TUBE CORP.
Manufacturers of Cathode-Ray Tubes and Electronic Products
69 FIFTH AVE., HAWTHORNE, N. J. • TEL. HAWTHORNE 7-3907

Now you can readily design your Electronic Equipment for unitized PLUG-IN UNIT CONSTRUCTION



New free Alden Handbook simplifies plug-in unit design. Presents complete line of basic components of tremendous flexibility for adapting your equipment to plug-in construction.

1 Unitize your circuitry in compact vertical planes using Alden Terminal Card Mounting System.


PRE-PUNCHED TERM. MTG. CARD
+
MINIATURE TERMINALS
+
JUMPER STRIP Eliminates wiring for common circuits
+
CARD-MTG. SOCKETS
=
YOUR COMPLETED CIRCUITS

You can use Alden Terminal Mounting Card with Alden Miniature Terminals, Jumper Strip and Sockets staked to accommodate any circuitry—making complete units ready for housing. Components snap into unique Alden Terminals, are held ready for soldering.

2 Make your circuits neat accessible plug-in units by mounting in Alden "20" Package or Basic Chassis.

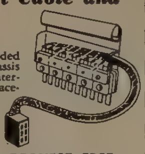
Alden components provide standard plug-in or slide-in housings—with spares, your circuits become units replaceable in 30 seconds.

3 Monitor your plug-in units with ALDEN SENSING ELEMENTS that spot trouble instantly.

4 Get fool-proof unit interconnections and accessible check points with Alden Unit Cable and Back Connectors.

BACK CONNECTORS & UNIT CABLE

Alden Back Connectors give accessible color coded check point for all incoming and outgoing chassis leads. Can be built into Unit Cables that interconnect between chassis and are instantly replaceable with spares.



121 N. MAIN ST., BROCKTON 64, MASS.

NA-ALD **ALDEN PRODUCTS Co.**

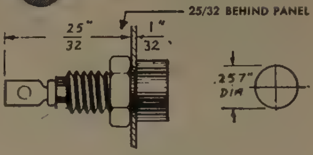
REQUEST FREE "ALDEN HANDBOOK"

Get instant voltage checks from front of your equipment

ALDEN MINIATURE TEST POINT JACK

FITS ANYWHERE
TAKES UP TO 8,000 V.

. . . 1 JACK TO STANDARDIZE ON



For a front panel test point of any critical voltage in your equipment, use this Alden Miniature insulated Jack. Standard on major Gov't. contracts and equipments. Soldered in "nothing flat," it takes very little space, can be located in any accessible place—all you need is a ¼" hole, yet stands up to 8,000 V. breakdown test.

Special punch press beryllium copper contact—retains live action over thousands of insertions—has generous solder tab with wire hole for rapid, fool-proof soldering.

Insulation: available with phenolic insulation for low water absorption, high heat resistance and excellent aging characteristics, in red, black, brown (MIL-P-MA) and blue, green, tan colors. Also available with nylon insulation in brilliant black, red, white, orange, blue, yellow colors.

Send for Laboratory Work Kit #9 containing 27 Jacks and 1 Test Prod. $5.00.

ALWAYS . . . "on the beam" with Standard Piezo CRYSTALS

If it is important for your transmitting and receiving equipment to stay "on the beam"—always, regardless of atmospheric extremes and rough handling—be sure to specify Standard Piezo Crystals. They're built to take it. Send for our completely illustrated catalog or submit your problems to our engineers for recommendations.

Standard Piezo Co.
CARLISLE, PENNA

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 111A)

Spectrograph Chart

A new 17½×22½ inch X-Ray Spectrograph Chart, showing characteristic secondary x-ray beams for elements from Sodium (Atomic #11) to Uranium (Atomic #92), is available gratis from the **Research & Control Instruments Div. North American Philips Co., Inc.**, 750 S. Fulton Ave., Mount Vernon, N. Y.

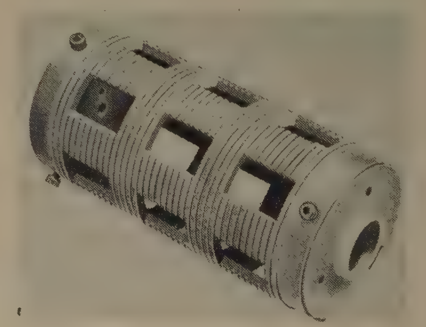
The new chart is suitable for wall display and will greatly assist scientific personnel in understanding the theory and principles of X-ray Spectrography and will be useful in handling actual problems.

Chart shows K Alpha and K Beta lines for mica (reflecting) analyzing crystal, for quartz analyzing crystal, for lithium fluoride analyzing crystal and rock salt analyzing crystal. It also shows L Alpha$_1$ and L Beta$_1$ lines, 1st and 2nd orders, for rock salt analyzing crystal.

Horizontal scale on chart shows 2 Theta Angle in degrees as read on the X-ray Spectrograph. Horizontal scale also shows wavelengths in Angstroms for all elements under various conditions.

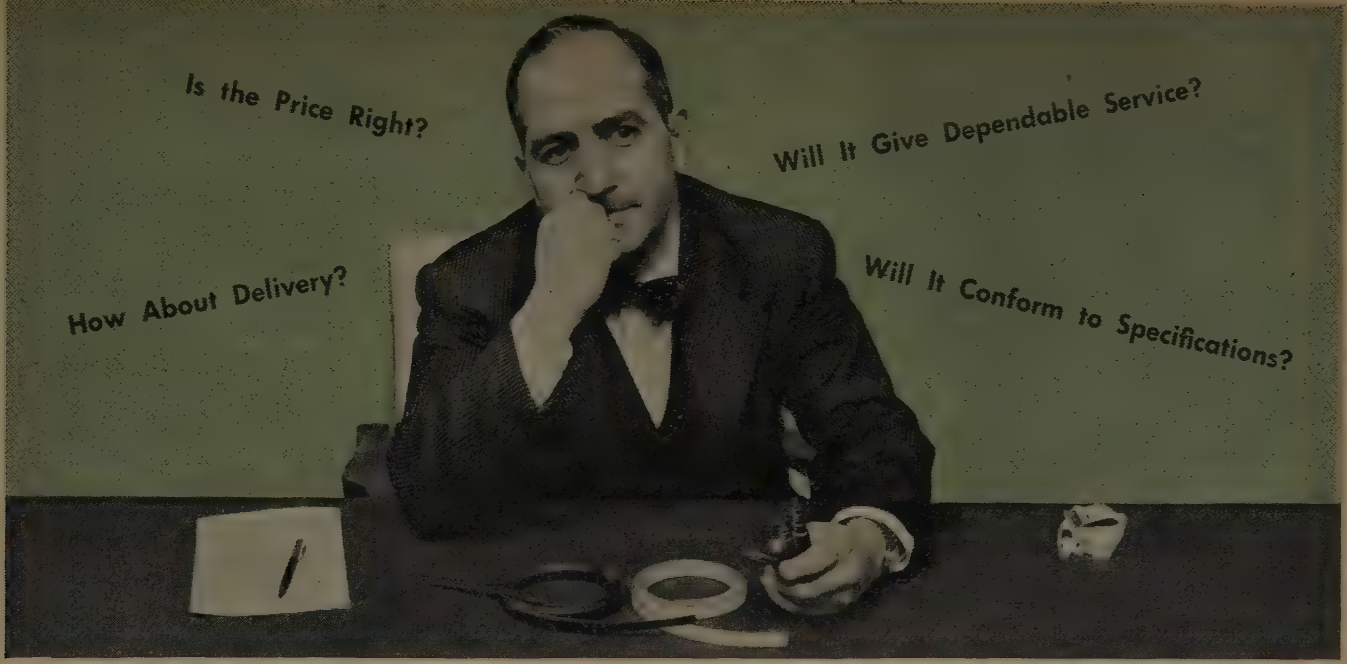
Coil Forms

The complex coil form shown illustrates one product usage of Mycalex 410, glass-bonded mica dielectric produced by **Mycalex Corp. of America**, Clifton Blvd., Clifton, N. J. This coil form is an assemblage of 3 parts, each injection-molded to very close tolerance. Metal inserts molded-in-place permit rapid assembly of the piece after coil winding or fast dismantling for coil replacement. High dimensional accuracy results in complete interchangeability of the pieces. Both the operating frequency and operating voltage are high and wide variations and extremes of temperature and humidity are likewise encountered in the application of this unit.



The manufacturer claims that the material is non-porous. It has lasting dimensional stability and withstands severe shock and vibration. Its electrical desirabilities include high dielectric strength and arc resistance, high volume resistivity, permanent electrical stability and a very low loss factor throughout the electromagnetic spectrum to above 24,000 mc.

(Continued on page 114A)

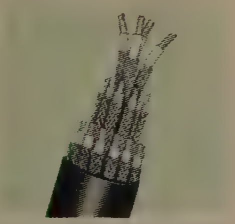

Is the Price Right?
Will It Give Dependable Service?
How About Delivery?
Will It Conform to Specifications?

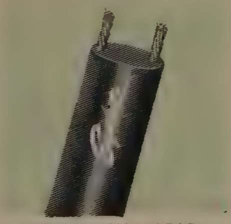
CHOOSE SYNKOTE CABLE AND WIRE

for Value — for Service — for Dependability

FIRST IN COMMUNITY TV: this ultra-rugged Synkote coax cable (RG 59/U and 11/U) is *double-shielded* and *double-jacketed,* transmits signals over long distances with virtually no radiation losses.

NEW FOR UHF: Synkote "Ovaltube" twin-lead is a tubular air-dielectric construction, features low attenuation. Fits ordinary hardware, can be made weathertight in seconds. Uniquely practical, nothing else like it.


30 CONDUCTOR CABLE: — a Synkote custom-engineered cable designed and manufactured from simple specifications *read over the telephone.* Difficult-looking, but "duck-soup" to Plastoid engineers.


"JUMBO" TWIN-LEAD: — 185 mil web—the strongest TV lead-in ever introduced. Withstands gales, extreme heat, cold and humidity. Low loss — gives excellent reception in fringe areas.

1. Choose for Dependable Construction

You want to be sure that the wire you buy will give dependable service. SYNKOTE wire is *warranted by Plastoid* to be made of the finest materials, and will meet all applicable specifications.

2. Choose for Engineering Know-How

Possibly, you may know what general characteristics you desire, but not how to put these into wire. Plastoid's large staff of engineers can transform your generalized requirements into a finished wire or cable. Simply give us your electrical and physical requirements — we'll design the cable.

3. Choose for Rapid Delivery

Plastoid's modern manufacturing facilities mean faster production . . . more rapid deliveries to you.

4. Choose for Friendly Service

You'll find everyone at Plastoid — executive, salesman or engineer — friendly, warm and informal . . . pleasant to work with and eager to do business with you.

5. Choose for Reasonable Cost

Remember, "bargains" seldom save you money. In the long run, it pays to pay a fair price and get dependable wire. For true wire economy specify SYNKOTE — manufactured only by Plastoid Corporation, Long Island City, New York

Synkote®
DEPENDABLE
Wire and Cable

"Manufactured by the mile - tested by the inch"

PLASTOID
Corporation

plant: HAMBURG, N. J. • offices: 42-61 24th St., Long Island City, N.Y.

IT'S **ALLIED** FOR RCA

AUTHORIZED RCA DISTRIBUTOR

ELECTRON TUBES FOR INDUSTRY

Quick, Expert Service on RCA Tubes

ALLIED maintains in stock for quick shipment, the world's largest distributor inventory of RCA special-purpose tubes. We specialize in supplying the needs of industrial, broadcast, governmental and other users. To save time, effort and money—phone, wire or write to ALLIED. Fill all your electronic needs from one complete reliable supply source.

ALL TYPES IN STOCK

- Vacuum Power
- Thyratrons
- Vacuum & Gas Rect.
- Ignitrons
- Cold-Cathode
- Phototubes
- Oscillograph Tubes
- Camera Tubes
- Monoscopes
- Special Types

FREE Interchangeability Directory

Valuable guide to selection of proper RCA tube type replacements. Lists 1600 tube types. Write today for this FREE RCA Guide No. 37-046.

1953 ALLIED CATALOG

Refer to your ALLIED Catalog for all electronic supplies—parts, tubes, test instruments, audio amplifiers, accessories—available from the world's largest stocks. Write today for FREE 1953 ALLIED Catalog.

Everything in Electronics
FROM ONE RELIABLE SOURCE

ALLIED RADIO
833 W. Jackson Blvd., Dept. 35-A-3
Chicago 7, Ill.

FREE CATALOG!—Send for it now!

Getting to the bottom of things

Tradition of the true engineer and scientist . . . no thought of personal glory . . . only satisfaction in the development of those things which contribute most to a better civilization . . . tireless in his never-ending search for something finer . . . such is the heritage of the engineering profession . . . to these we owe much.

FAST engineers, true to their profession . . . forward looking; searching beyond the horizon and planning ahead; ever seeking those refinements that make their product better to fit the needs of TOMORROW'S equipment . . . are eager to help you plan for the new day just ahead.

How well they are prepared to cope with tomorrow's problem can be demonstrated by their use of X-Ray as an instrument in the development of finer capacitors . . . 1935* found them applying this scientific device as part of research and manufacturing procedure . . . another proof of FAST *years-ahead investigation and getting to the bottom of things.*

SPECIALISTS IN: Fixed Paper Dielectric Capacitors in Oil or Wax; Impregnated and Filled, or Polystyrene Film Units. In Cardboard or Metal, Rectangular or Tubular Containers. For use in Electrical, Radionic, Scientific or Television Equipment.
Power-Factor Correction Capacitors, Heavy-Wire (No. 12 to No. 20) Choke Coils, air or iron core, for RF or Radio Noise-Suppression.

**See HERMAN E. SEEMANN, PHYSICIST, KODAK RESEARCH LABORATORIES, "Miscellaneous Applications of Radiography and Fluoroscopy," Symposium on Radiography and X-Ray Diffraction Methods, American Society for Testing Materials, Philadelphia, Pa.* (1937).

AVAILABLE LITERATURE:
Tubular Capacitors in paper tubes. 65° or 85°C rating.................................. SEC. I, CATALOG 25
Polystyrene Capacitors in paper tubes or metallic containers.............................. SEC. IV, CATALOG 25
Hermetically-sealed Tubular Capacitors........ SEC. VI, CATALOG 25
Subminiature Capacitors: Special Bulletin.
Jan C-25 Approved Capacitors: refer to Jan C-25, "Specifications"
Power-Factor Correction Capacitors SECS. I, II, III, IV, CATALOG 27

JOHN E. FAST & CO.
Capacitor Specialists for Over A Third of A Century
3177 North Pulaski Road, Chicago 41, Ill.
"WHEN YOU THINK OF CAPACITORS . . . THINK FAST"

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 112A)

Brushless Generator

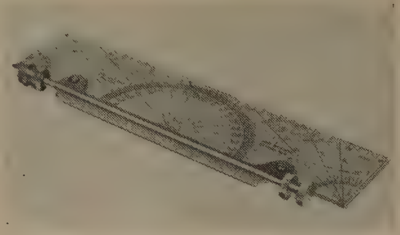
The Georator Corp., Electric Products Div., Arlington 9, Va., announces its improved "Nobrush" electric generator. This generator, featured in a 400-cycle type, avoids brushes entirely by a permanent magnet construction.

Among the advantages attained by this construction are immunity to damage by moisture, immunity to damage by overhead or short circuit durability and long life, reduction in size and weight, almost total elimination of maintenance, and elimination of radio interference.

Units are furnished for belt drive or for mounting on driving motor or engine. Complete motor-generator or engine-generator sets are available.

The generator is adapted for aircraft use, for field or laboratory supply, for portable power units, for mounting in marine craft or vehicles, or for operation of newer high-frequency portable power tools. Outputs range from 250 va to 25 kva. Usual voltages, single or three phases, are provided. Request Circular E 10.

Pocket Size Drafting Tool



Loomis Industries, Box 442, Berkeley 1, Calif., has a new drafting aid, "Paraline," which, in one instrument, provides T-square, Straight-edge, Triangle, Protractor, $\frac{1}{32}$nd inch scale, and Parallel Rules. It measures $10\frac{1}{4} \times 3\frac{3}{16}$ inch and requires no attachments or board clamps. Selling price is $2.95 plus 8¢ postage. (Add 3 per cent sales tax for State of California.)

Improved model Paraline now has metal parts incorporated in one sturdy section, thus eliminating slippage.

(Continued on page 115A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 114A)

Preset Counter

Berkeley Scientific Co., Div. Beckman Instruments, 2200 Wright Ave., Richmond, Calif., announces its new Preset Counter using from two to six Model 730 preset decimal counting units. The counter is a high speed electronic counter with provisions for obtaining output information at any count up to the maximum capacity of the unit. The output information can be in the form of a + 125 volt pulse or 1/30 of a second relay closure. Any discrete physical change from 0 to 40,000 times per second that can be converted into a changing voltage can be counted.

(Continued on page 116A)

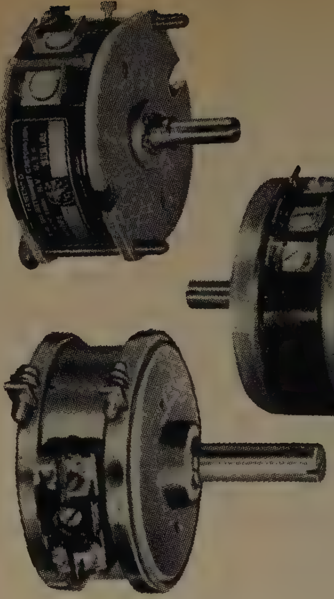
MICO

Precision Apparatus

UHF COAXIAL WAVEMETERS

MODEL 433 . . 20 to 75 Centimeters
MODEL 501 . . 4 to 20 Centimeters
MODEL 402A . . 2 to 10 Centimeters
MODEL 402B . . 2 to 10 Centimeters
(Reaction Type)

MICO INSTRUMENT CO.
79 TROWBRIDGE ST., CAMBRIDGE, MASS.



Need
Linear and
Non-Linear
ACCURATE
Functions?

Use Fairchild Precision Potentiometers

Experience with Fairchild potentiometers in hundreds of applications shows that these units are unusually precise. Accuracies of ±1% in non-linear types and as high as ±0.05% in linear types can be guaranteed. Service life as high as 10,000,000 cycles, under certain conditions, also can be provided. High resolution, low torque, and low noise level are other performance features worth noting.

Fairchild Precision Potentiometers perform mathematical computations in electrical computing systems for machine-tool controls, process controls, telemetering, guided missiles, flight control, fire control, and analog computers of all types. They are available in non-linear and linear types and in ganged combinations of either or both windings to meet your requirements.

Use the coupon below to get full details.

FAIRCHILD
PRECISION POTENTIOMETERS

THIS COUPON MAY HELP SOLVE YOUR POTENTIOMETER PROBLEMS!

Department 140-32H
Potentiometer Division
Fairchild Camera and Instrument Corporation
Hicksville, Long Island, New York

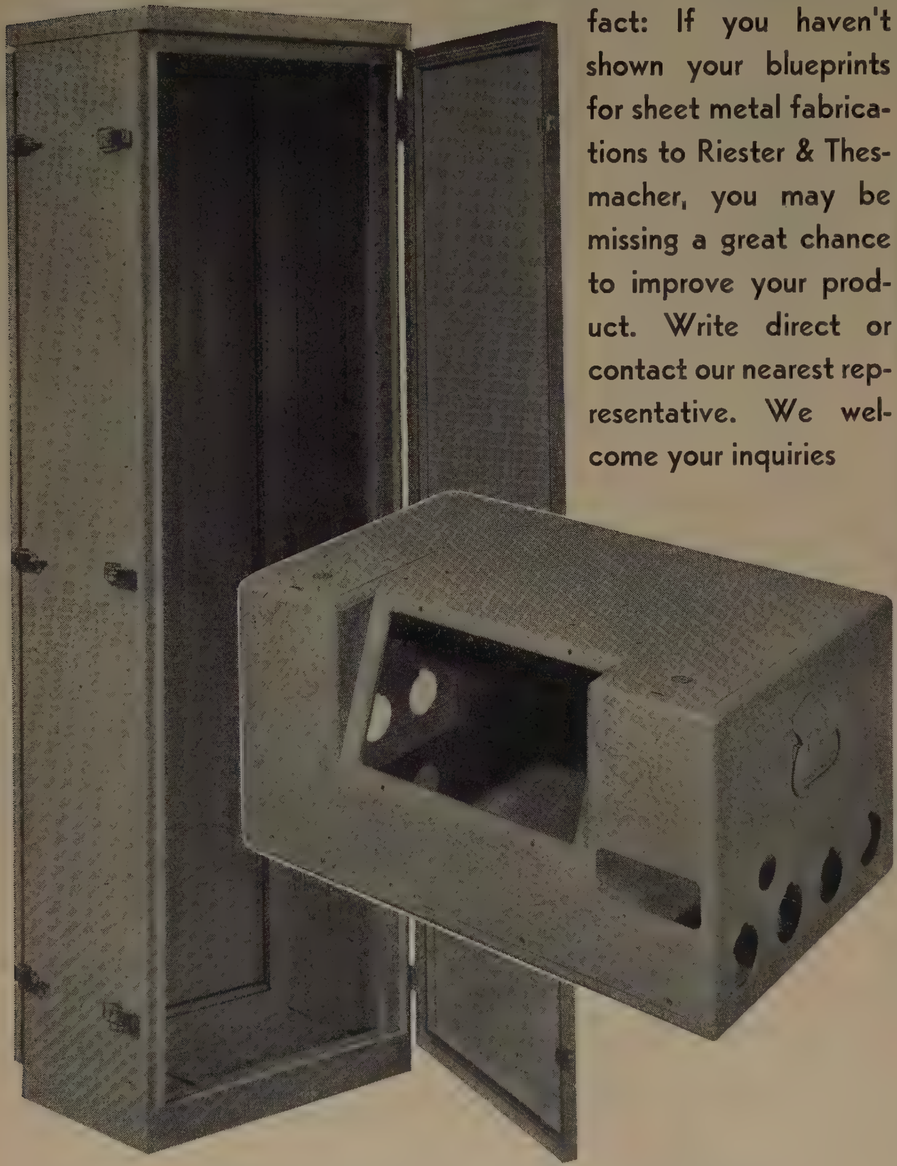
Gentlemen:

Please send me complete information about Fairchild Precision Potentiometers, and tell me how you might solve my potentiometer problems.

Name ____________________
Title ____________________
Company ____________________
Address ____________________
____

IN THIS CASE QUALITY MEANT
RIESTER & THESMACHER

Higher quality, finer workmanship at a reasonable cost adds up to this important fact: If you haven't shown your blueprints for sheet metal fabrications to Riester & Thesmacher, you may be missing a great chance to improve your product. Write direct or contact our nearest representative. We welcome your inquiries



Aluminum Spot Welding • Heliarc Aluminum Welding

• REPRESENTATIVES •

Frank W. Taylor Co.
P.O. Box 316, DeWitt, N.Y.

Paul R. Sturgeon
25 Huntington Ave., Boston 16

Kenneth E. Hughes Co.
17 W. 60th St., New York 23

Samuel K. Macdonald, Inc.
1531 Spruce St., Philadelphia 2

William E. McFadden
150 E. Broad St., Columbus 15, Ohio

MANUFACTURERS
Special Steel Equipment
Metal Cases – Cabinets
CONTRACTORS
Sheet Metal
Building Products
VENTILATION,
AIR CONDITIONING

THE
RIESTER & THESMACHER
COMPANY
1526 W. 25TH ST. CHerry 1-0154
CLEVELAND, OHIO

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 115A)

Film and Oscillograph Record Reader

Faster, more accurate measurements of film and oscillograph records are now possible with the development of the Universal Telereader, by the **Telecomputing Corp.**, 133 E. Santa Anita Ave., Burbank, Calif.

The Universal Telereader measures records ranging from 16 and 35 mm film to 12 inch oscillograph paper measuring up to 100 feet in length. It can handle either translucent or opaque records.

Three interchangeable projection lenses are provided with the Telereader to permit record magnification of 2×, 4× and 11×, depending on the need.

When used with companion instruments such as Telecomputing's Telecordex and a summary punch, the Universal Telereader can print its measurements in decimal form on a typewriter supplied with the Telecordex, as well as recording such information into punched cards.

Band Pass Filter

Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass., announces a new Band Pass Filter, Model 310-A.

The Model 310-A is an adjustable band pass filter with unity pass gain and 24 db/octave slopes outside the pass band. A peaking factor is used to reduce the attenuation at the cut-off frequencies.

(Continued on page 118A)

ELECTRONICALLY REGULATED

LABORATORY POWER SUPPLIES

BENCH MODEL 25

- STABLE
- DEPENDABLE
- MODERATELY PRICED

- **INPUT:** 105 to 125 VAC, 50-60 cy
- **OUTPUT #1:** 200 to 325 Volts DC at 100 ma regulated
- **OUTPUT #2:** 6.3 Volts AC CT at 3A unregulated
- **RIPPLE OUTPUT:** Less than 10 millivolts rms

WIDTH 14″
DEPTH 6″
HEIGHT 8″
WT: 17 LBS.

For complete information write for Bulletin N-5

LAMBDA ELECTRONICS CORPORATION
CORONA NEW YORK

Now

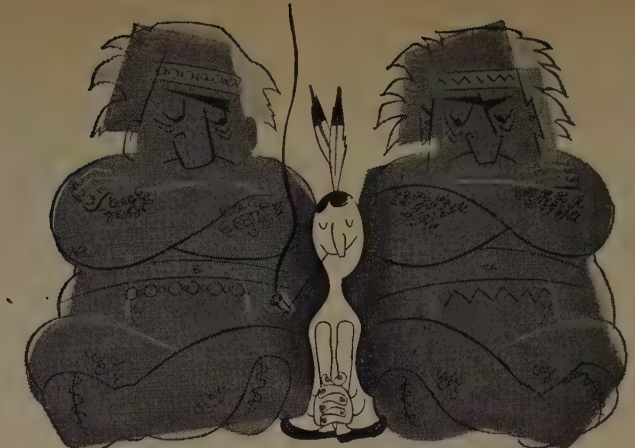
PL-4D21

POWER TETRODE

[illegible] DISSIPATION.
FULL RATINGS TO 120 Mc.
HIGH OVERLOAD CAPABILITIES.
AVAILABLE IMMEDIATELY.

For data, Write

PENTA LABORATORIES INC.
216 North Milpas Street
SANTA BARBARA, CALIFORNIA

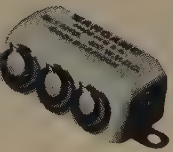


no seating problem

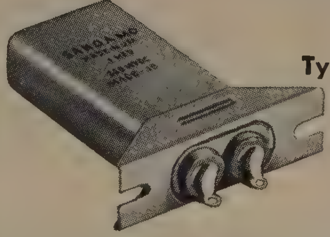
when you use Sangamo Paper Capacitors

They meet the physical and electrical requirements of JAN-C-25 specifications

Type CP 40
Space-saving, high-voltage filter capacitors for transmitting, receiving, or industrial electronic equipment. Easy to mount.



Type CP 50
Unusually small but stable by-pass capacitors of the "bathtub" type. Available in single, double, and triple section units.



Type CP 60
These filter capacitors are available with seamless drawn steel or non-magnetic cases that are *smaller* than JAN specs.

Type CP 70
Compact, fabricated can type for power supply in transmitting, sonar, radar, or ground control equipment.

Sangamo hermetically sealed paper capacitors for filter, by-pass, coupling or power supply applications can be furnished in types that give excellent performance with long life over a temperature range from −55° C to +125° C! Diaclor*, or mineral oil impregnation for 85° C operation—and Sangamo developed E-therm impregnation for exceptionally high thermal stability and superior electrical performance over a range of operating temperatures up to 125° C. Write for further information. Complete story in Catalog No. 800A and Engineering Bulletin No. 104.

*TM Registered (Chlorinated Dielectric Oil)

Those who know... choose Sangamo

SANGAMO ELECTRIC COMPANY
MARION, ILLINOIS

SC53-2

precision-made to your needs . . .

BENDIX-FRIEZ

thermistors

Maybe your need for these temperature responsive resistors can be satisfied by a type we carry in stock. Maybe you require a specially-developed type. In either case you can depend on Bendix-Friez to provide precision-made thermistors to serve you with maximum efficiency. High standards of quality control in manufacture make Bendix-Friez Thermistors pre-eminent in their field . . . assure you of utmost satisfaction.

STANDARD TYPES FOR IMMEDIATE DELIVERY

Size (inches)	@ +30°C.	@ 0°C.	@ −30°C.
.140 x .75	45.0 ohms	86 ohms	194 ohms
.040 x 1.5	12,250 ohms	26,200 ohms	65,340 ohms
.018 x 1.5	35,000 ohms	82,290 ohms	229,600 ohms

Write for details.

Used in this typical application for sensing the temperature of hydraulic oil.

FRIEZ INSTRUMENT DIVISION of . . .

Bendix AVIATION CORPORATION

1490 Taylor Avenue, BALTIMORE 4, MARYLAND

Export Sales: Bendix International Division
72 Fifth Avenue, New York 11, N. Y.

SECON

DEVELOPMENT and PRODUCTION METALLURGISTS

Fine wire and ribbon in base, rare, and precious metals, and alloys for new and highly engineered applications. In small units and sizes, and to close tolerances.

Further details on request.

SECON

SECON METALS CORPORATION
228 East 45th Street, N. Y. 17, N. Y., MU 7-1594

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 116A)

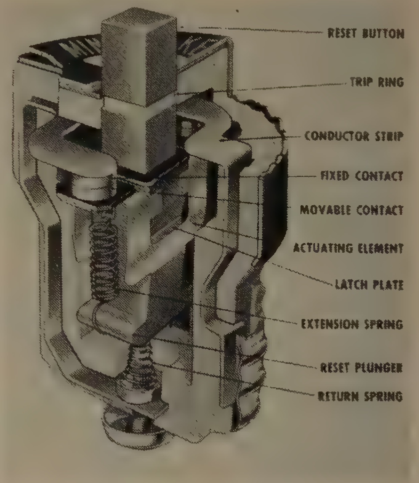
Both the high and low cut-off frequencies are independently adjustable from 20 cps to 200 kc. This provides maximum flexibility of adjustment of both the band center frequency and the band width.

The Model 310-A is especially useful in the audio and ultrasonic frequency range for noise measurements, harmonic and frequency analysis, and for psychoaccoustics and electro-medical research. The unit measures 12×7×8 inches over all and sells for $275.00. A descriptive pamphlet is available on request.

Circuit Breaker

Mini-Breaker, a new permanent-circuit protective device that fits like a fuse in any standard Edison base fuseholder delivering up to 125 volt ac service is available from **Mechanical Products Corp.,** 1824 River St., Jackson, Mich. It requires no additional equipment and no special wiring when applied to branch or main circuits of corresponding 15, 20, or 30 ampere ratings.

To merit listing under the product classification "Circuit Protector" Mini-Breaker is required to: (1) safely interrupt 5,000 ampere, 125 volt dc calibrated circuit once. (2) trip at 200 per cent load within 120 seconds at 250°F.; and trip at 12 per cent load within one hour at 25°C. (3) complete 35 cycles manual make and break at 150 amperes for the 15 and 20 ampere devices, at 180 amperes for the 30 ampere device; complete 15 cycles manual make and automatic break at same overloads, with both tests conducted at 125 volts, ac, 60 cps, 50 per cent power factor. (4) make and break its rating in tungsten filament lamps four times at two minute intervals without automatic trip or welding of contacts. (5) carry its rated current indefinitely, with rise on center contact and screw shell not exceeding 50°C. (6) interrupt calibrated 5,000 ampere circuit, 125 volts ac, 60 cps at 50 per cent power factor three times. (7) meet dielectric strength requirements after completing the ac short circuit test.



(Continued on page 120A)

Now . . .

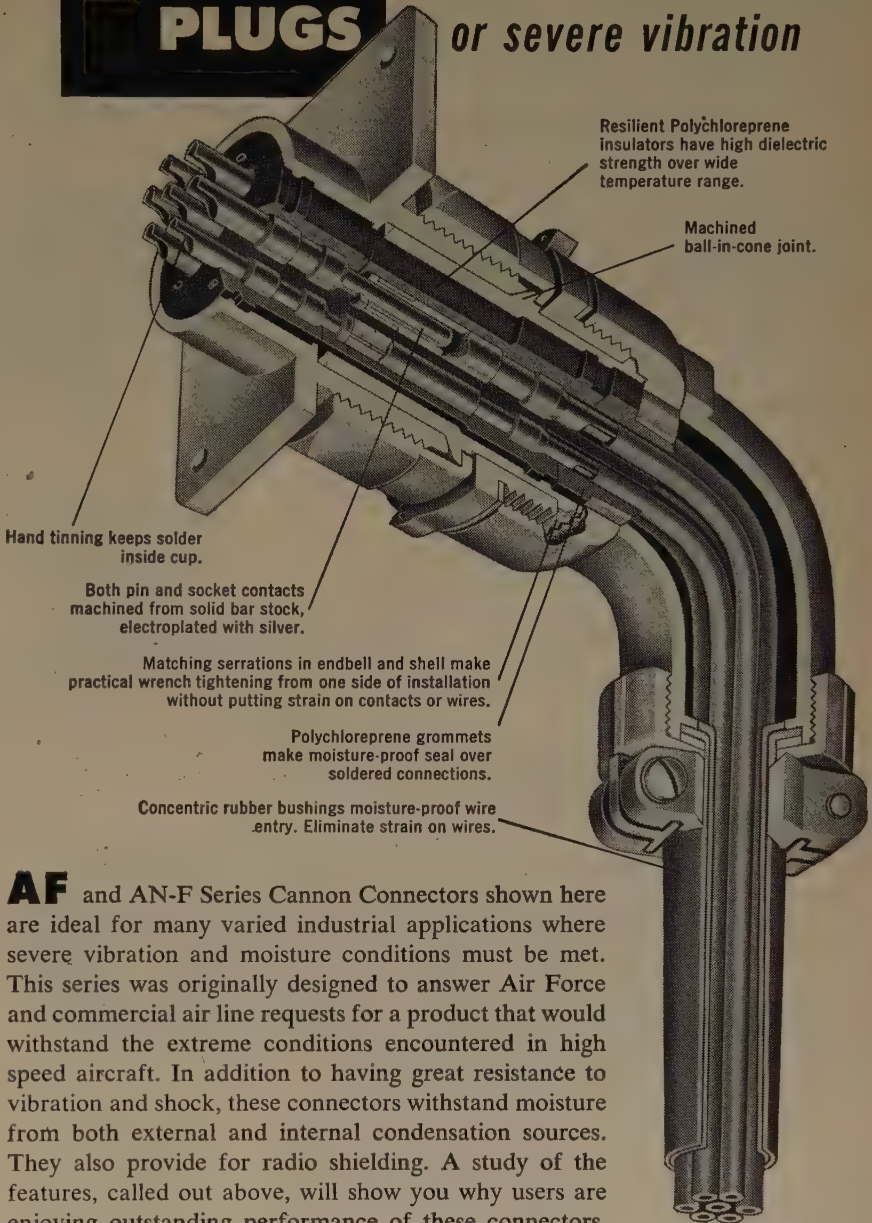
a new
group of
TERMINALS
especially
designed
for use in the
U.H.F. region . . .
available
in both
feed-thru
and
stand-off types . . .
for
hermetic or
non-hermetic
applications.

•

Design engineers . . .
for further
information,
write to . . .

Lundey Associates
694 Main Street
Waltham 54,
Massachusetts

CANNON PLUGS to withstand moisture or severe vibration



Resilient Polychloroprene insulators have high dielectric strength over wide temperature range.

Machined ball-in-cone joint.

Hand tinning keeps solder inside cup.

Both pin and socket contacts machined from solid bar stock, electroplated with silver.

Matching serrations in endbell and shell make practical wrench tightening from one side of installation without putting strain on contacts or wires.

Polychloroprene grommets make moisture-proof seal over soldered connections.

Concentric rubber bushings moisture-proof wire entry. Eliminate strain on wires.

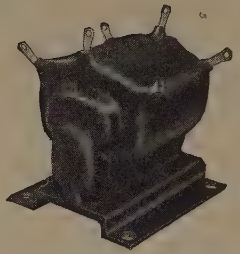
AF and AN-F Series Cannon Connectors shown here are ideal for many varied industrial applications where severe vibration and moisture conditions must be met. This series was originally designed to answer Air Force and commercial air line requests for a product that would withstand the extreme conditions encountered in high speed aircraft. In addition to having great resistance to vibration and shock, these connectors withstand moisture from both external and internal condensation sources. They also provide for radio shielding. A study of the features, called out above, will show you why users are enjoying outstanding performance of these connectors. The machined ball-in-cone joint, while not obvious, plays an important part in providing radio shielding and improved vibration and moisture resistance. For engineering data request Cannon's AN Bulletin.

The Cannon AF Series consists of 2 plug types and 3 receptacles in 15 diameters. Contact arrangements closely follow those in the AN Series. Shells are cadmium plated. The sturdy hex shaped coupling nut shown here is used on sizes 8S through 18. Larger diameters have a strong spline type coupling nut to fit spanner wrenches. Knurled type coupling nuts are available to meet AN-F specification.

CANNON ELECTRIC

Since 1915

Factories in Los Angeles, Toronto, New Haven, Benton Harbor. Representatives in principal cities. Address inquiries to Cannon Electric Company, Dept. A-377, P.O. Box 75, Lincoln Heights Station, Los Angeles 31, Calif.



MINIATURIZATION

Thru constant research, Acme transformer engineers have developed designs, that save pounds and ounces in weight and provide long-life performance. We build miniature transformers by the thousands, each individually performance tested.

PRESSURIZED SEAL

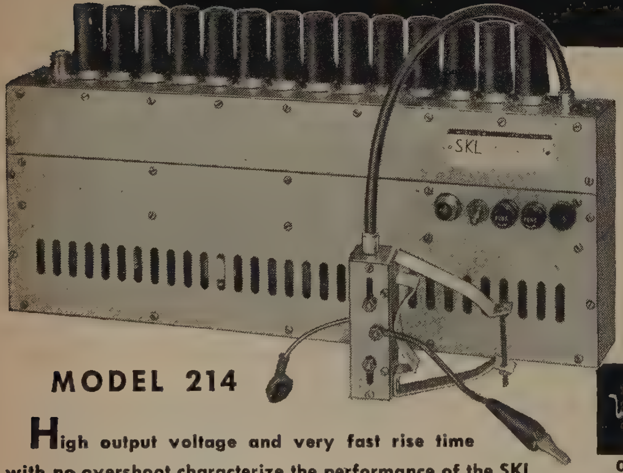
Here is a transformer design with terminals sealed under pressure with a resilient sleeve that accommodates expansion and contraction of temperature changes.

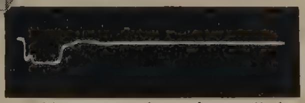
PLASTIC COATING

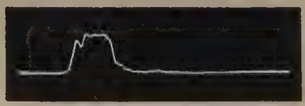
This is one of a number of ways that plastic has been adapted to seal transformers or individual coils for service in humid atmospheres or under conditions which breed fungi.

Acme Electric TRANSFORMERS

ACME ELECTRIC CORPORATION
441 WATER STREET • CUBA, NEW YORK
IN CANADA: ACME ELECTRIC (CANADA) LTD.
824 NOTRE DAME ST., WEST • MONTREAL, CANADA







100 MC BANDWIDTH PULSE AMPLIFIER

FEATURES

MAX. OUTPUT VOLTAGE
125 volts

RISE TIME
.006 usec.

GAIN
30 db

INPUT IMPEDANCE
180 ohms

BANDWIDTH
40 KC to 100 MC

MODEL 214

High output voltage and very fast rise time with no overshoot characterize the performance of the SKL Model 214 Chain Pulse Amplifier. The specially designed terminating cable provides a resistive output of 500 ohms and a capacitive output for connection to a cathode ray tube grid or deflection plates. Capable of deflecting a 5XP tube more than 1", the Model 214 finds extensive use in radar, oscillography, television testing, and nuclear physics.

Write today for further information.

0.06μ sec complex pulse applied directly to oscilloscope plates. Rise time approx. 0.001μ sec.

Pulse through Model 202P Wide Band Chain Amplifier and Model 214 Chain Pulse Amplifier (50 db gain). Note reproduction of fine detail.

SKL SPENCER-KENNEDY LABORATORIES, INC.
186 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 118A)

Components Catalog

Titeflex, Inc., 500 Frelinghuysen Ave., Newark N. J., announces a new twelve page catalog describing its line of microwave components.

This booklet includes detailed specifications for both rigid and flexible waveguides plus schematic diagrams and application charts.

Titeflex rigid waveguides conform to the MIL-T-85B specification and are recommended for installations where there is no movement of the transmission line or for those portions of a waveguide run requiring the inclusion of complicated accessories.

Waveflex flexible waveguides are produced by a method of convoluting strip metal. They are rubber-jacketed for protection against weather, corrosion and abuse and to prevent sharp bends and increase flexible life. The rubber jacket insures pressure sealing under operating conditions.

The interior of flexible waveguides and the inner surface of rigid waveguides are silver-plated to reduce attenuation losses and to prevent corrosion.

All Titeflex microwave components meet JAN specifications and each customer's specific requirements before shipment.

Scintillation Detector

A new scintillation detector, Model DS-1, designed for efficient gamma-ray counting, has been announced by **Nuclear Instrument & Chemical Corp.,** 229 W. Erie St., Chicago 10, Ill.

The new detector is provided with a thallium-activated sodium iodide crystal and has a plateau length of approximately 200 volts. With the external directional shield in place, efficiencies of 33 per cent or greater are obtainable using Cobalt 60, and 40 per cent or greater using Iodine 131. Model DS-1 detector is equipped with a removable directional shield, and has a built-in preamplifier which provides an output pulse in excess of one-quarter volt, making its use possible at the G-M input of any scaler or count-rate meter. It is available as a separate, complete unit; or with a special lead shield for sample counting.

(Continued on page 135A)

ENGINEERS-

Here is
North American's
Challenge
To You

Frankly, working at North American requires hard thinking and plenty of vision. Because North American always works in the future. Yet, if you are interested in advanced thinking, if you'd like to work on the planes that will make tomorrow's aviation history, you'll like working at North American. North American offers these extra benefits, too.

North American Extras—

Salaries commensurate with ability and experience • Paid vacations • A growing organization • Complete employee service program • Cost of living bonuses • Six paid holidays a year • Finest facilities and equipment • Excellent opportunities for advancement • Group insurance including family plan • Paid sick leave • Transportation and moving allowances • Educational refund program • Low-cost group health (including family) and accident and life insurance • A company 24 years young.

Write Today

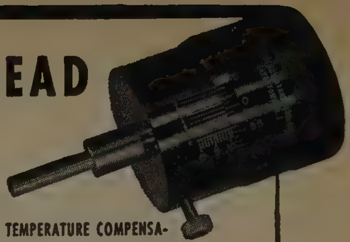
Please write us for complete information on career opportunities at North American. Include a summary of your education, background and experience.

CHECK THESE OPPORTUNITIES AT North American

- Aerodynamicists
- Stress Engineers
- Aircraft Designers and Draftsmen
- Specialists in all fields of aircraft engineering
- Recent engineering graduates
- Engineers with skills adaptable to aircraft engineering

NORTH AMERICAN AVIATION, INC.

Dept. 7, Engineering Personnel Office
Los Angeles International Airport
Los Angeles 45, Calif.; Columbus 16, Ohio
North American Has Built More Airplanes Than Any Other Company In The World



FS MICROMETER HEAD
for the Electronics Industry

ENGINEERS USING FS MICROMETER HEADS FOR VARIOUS APPLICATIONS FIND THE TEMPERATURE COMPENSATION CONSTRUCTION AND AUTOMATIC COMPENSATION FOR WEAR OF SPINDLE AND NUT THREAD CONTRIBUTING FACTORS TO THE INSTRUMENT'S PRECISE ACCURACY . . . A DEGREE OF ACCURACY IN READING, HITHERTO UNATTAINABLE IN ANY MICROMETER HEAD. SEND TODAY FOR YOUR COPY OF THE NEW DESCRIPTIVE BULLETIN.

FREQUENCY STANDARDS
P. O. BOX 66, EATONTOWN, N. J. • TELEPHONE ASBURY PARK 1-1018

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 120A)

Gamma Ray Counter

Nucleonic Co., of America, 497 Union St., Brooklyn 31, N. Y., now has available for early delivery a sensitive gamma ray geiger tube. This metal tube is six times more sensitive to gamma radiation from radio active iodine than other tubes of similar dimensions. It contains a bismuth cathode, and has a standard four prong connector: overall length is 8 inches; diameter is 1 inch.

In addition, a wide variety of metal cosmic ray tubes possessing excellent plateau characteristics are also available now for early delivery. More information about these tubes and other nuclear products can be obtained by writing to the company.

(Continued on page 136A)

Opportunities At
BECKMAN
for
ENGINEERS - SCIENTISTS
To Develop Instruments and Electronic Components

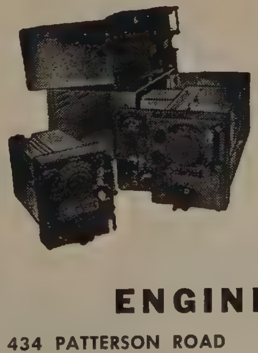
Use your training, aptitudes and experience in the following (or allied) fields: Spectroscopy . . . Precision Electronics Optics . . . Physics . . . Electromechanics Mechanics . . . Feedback Systems

Men who combine fields will find our projects especially interesting. Typical developments include spectrophotometers at all wavelengths, pH meters, electrometers, flame photometers, computers, radiation instruments, titrators and others to be announced.

Unusual opportunities in all divisions: Helipot and Beckman Instruments—So. Pasadena, California; Berkeley Scientific—Richmond, California. Our company is a leader in the fast growing instrument industry, *which is not dependent for its future on military contracts, but is of fundamental importance to all types of research and industry.*

Write for application and information about our company.

Personnel Department
BECKMAN INSTRUMENTS, Inc.
1001 El Centro Street
South Pasadena 187, California



AN/APR-4 LABORATORY RECEIVERS

Complete with all five Tuning Units, covering the range 38 to 4,000 Mc.; wideband discone and other antennas, wavetraps, mobile accessories, 100 page technical manual, etc. Versatile, accurate, compact—the aristocrat of lab receivers in this range. Write for data sheet and quotations.

We have a large variety of other hard-to-get equipment, including microwave, aircraft, communications, radar; and laboratory electronics of all kinds. Quality standards maintained. Get our quotations!

We will buy any Electronic Material at top prices. SCHOOLS—unload your dusty surplus for cash or credit.

ENGINEERING ASSOCIATES
434 PATTERSON ROAD
DAYTON 9, OHIO

EXPANDED FACILITIES

at your service

Your electron tube problems will now receive even finer, fuller, and faster attention at Lewis and Kaufman through absorption of the personnel and production facilities of Pacific Electronics, Saticoy, California. Top management of Lewis and Kaufman will remain unchanged and the Los Gatos Brand will be applied to all products.

Special tube developments will receive added emphasis in the enlarged organization. You are invited to submit your problems, whether for special or standard long-lived Los Gatos types. Contact your nearby field representative or write direct.

LEWIS and KAUFMAN, Ltd.
LOS GATOS 2 CALIFORNIA

LOS GATOS LONG LIFE

Positions Wanted

(Continued from page 133A)

PHYSICIST

BS in physics with minor in E.E. 3 years experience in application of electromagnetic waves. Desires location permitting further academic study either days or nights. Box 628 W.

ENGINEER

Naval Reserve officer, now on active duty with the Office of Naval Research, expects release end of 1952. 11 years electronic experience including development, administration and instruction. BEE and MEE degrees; continuing graduate studies. Married, age 34. Desires executive or administrative position in New York or New England area. Box 609 W.

ENGINEER

BSEE Purdue, 1948. Age 35, married. 6 years operation-maintenance military electronic equipment. Several years experience design and development of communications and navigational equipment, technical writing, teaching, broadcast station operation. Available part-time. New York City vicinity. Box 610 W.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 135A)

Dummy Loads

Airtron, Inc., 20 E. Elizabeth Ave., Linden, N. J., has developed a series of high power dummy loads which have been tested at power levels up to the breakdown level of the waveguide size for which they are intended, and show that they are capable of operating at peak levels and under conditions equivalent to that of rigid waveguide.

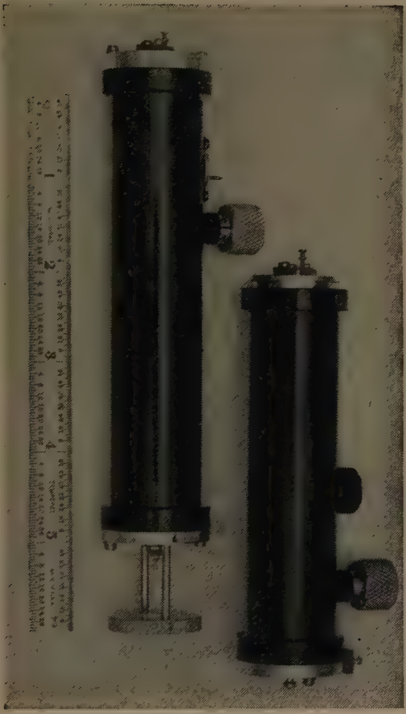
They have a built-in metallic taper in the broad faces of the guide to provide for uniform power dissipation over the total finned area, thereby reducing the hot spots so common with standard dissipative-wall dummy loads.

Dummy loads are available with an average power dissipation equal to or greater than any existing radar system today and for the peak power rating of rigid wave guide.

They are available in all waveguide sizes from $1\times\frac{1}{2}$ to $3\times1\frac{1}{2}$.

(Continued on page 138A)

MINIATURIZED S-BAND CAVITIES



Originated by C.G.S. Laboratories, Inc., these S-Band Cavities have been perfected in cooperation with Signal Corps Engineering Laboratories. They utilize the new pencil tube series and meet all applicable JAN specifications.

TYPICAL DATA

Length—4-½″
Diameter—1″ (less projections)
Weight—8 oz.
Output—CW units—minimum 25 mw
Pulse units—300-1000 Watts peak
Tunable range—Pulse—up to 400 Mc
—highest attainable frequency—3400 Mc
CW—up to 400 Mc
—highest attainable frequency—3000 Mc
Temperature Drift—As low as ±2 Mc from —50°C to +70°C

Write for detailed specifications—determine how the C.G.S. Miniaturized Cavity can solve your particular problem.

C. G. S.
LABORATORIES
INC.
391 LUDLOW ST.
STAMFORD, CONN.

ELECTRONICS

SPACE SAVERS

For Modern Electronics

JOHNSON

miniature air variables

Capacitors too can turn on a dime . . . and require just a ⅝″ x ¾″ panel area! Johnson miniatures are designed to solve the space and dependability problem in modern portable, mobile and airborne equipment through the VHF range. You can depend on Johnson quality to maintain the high standards of your equipment.

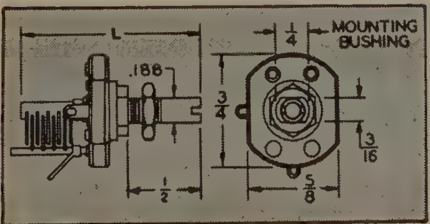
SPECIFICATIONS

CAT. NO.	NOMINAL MAX.	CAP. MMF. MIN.	NO. PLATES	L
SINGLE				
5M11	5.0	1.5	5	1-7/64
9M11	8.7	1.8	9	1-7/32
15M11	14.2	2.3	15	1-13/32
20M11	19.6	2.7	21	1-37/64
DIFFERENTIAL				
6MA11	5.0	1.5	7	1-7/64
9MA11	8.7	1.8	13	1-7/32
15MA11	14.2	2.3	22	1-13/32
19MA11	19.6	2.7	31	1-37/64
BUTTERFLY				
3MB11	3.1	1.5	7	1-7/64
5MB11	5.1	1.8	13	1-7/32
9MB11	8.0	2.2	22	1-13/32
11MB11	10.8	2.7	31	1-37/64

The Miniature Size with All Full Size Features!

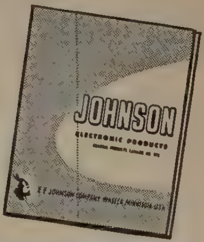
• Low inductance • Soldered plates assembled with precision • Split sleeve bearings • Beryllium copper tension spring contact for permanent alignment, constant torque and low inherent noise • Differential and butterfly types electrically symmetrical • Excellent vibration characteristic due to low inertia • Steatite insulation impregnated with DC-200 • Metal parts brass, nickel plated • Single hole mounting bushing threaded ¼-32 with flats to prevent turning • 3/16″ shaft slotted for screw driver adjustment • Plate spacing .017″ • Peak voltage rating, 1250.

Features available in production quantities: Locking bearing, 180° stop, various shaft extensions, .0135″ spacing with capacities up to 30 mmfd, high torque.



For Complete Information on the JOHNSON LINE

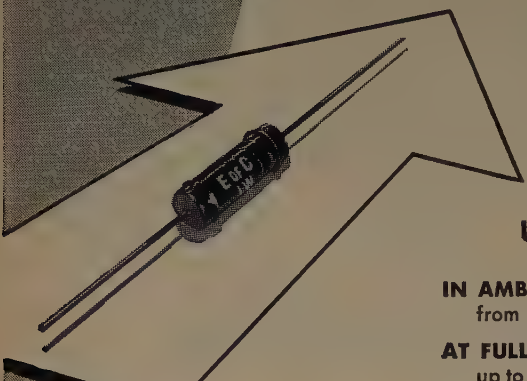
Write for Catalog 973



E. F. JOHNSON COMPANY

CAPACITORS, INDUCTORS, SOCKETS, INSULATORS, PLUGS, JACKS, DIALS, AND PILOT LIGHTS

204 2nd Ave. S. W. • Waseca, Minnesota



Precision Resistors

METAL FILM TYPE
1% TOLERANCE
for
HIGH STABILITY
Under Severe Conditions

IN AMBIENT TEMPERATURES
from 125° C. to −65° C.

AT FULL RATED LOAD
up to 100° C. ambient.

IN HIGH RELATIVE HUMIDITY
less than 1% change.

TEMPERATURE COEFFICIENTS
under 0.03% per degree C.

VOLTAGE COEFFICIENTS
less than 0.0005% per volt.

DURABLE—Remain stable over long periods. Difficult to damage by rough handling.

Available for use in equipment for the U. S. Government in 1 watt size in values from 1000 ohms to 1.0 megohm.

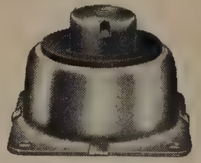
Write for details

Electronics of Colorado
1026 SOUTH TEJON STREET • COLORADO SPRINGS, COLORADO

FINNFLEX AIRBORNE MOUNTING BASES

Conform to JAN-C-172A SPECIFICATIONS ... but are actually made to *exceed* AN-E-19 Drop Test requirements

TYPE SR MOUNTING BASE



TYPE TPM VIBRATION ISOLATOR

RUGGED PROTECTION for VITAL EQUIPMENT: Finnflex Mounts isolate vibration and shock from *Electronic, Communication,* and *Control Equipment*. They offer unimpaired efficiency from −80° to +250°F., *"Selective Action"* friction dampening, non-linear steel springs, and other features. Wide range of sizes and load ratings available.

SHOCK MOUNTS for Signal Corps Mobile Equipment and for Naval Fire Control Units.

SPECIAL PROBLEMS: Complete facilities for designing and fabricating Shock and Vibration Mounts to order — *regardless* of size or weight of equipment mounted.

Specify FINNFLEX—for Ruggedness, Efficiency, and Economy.

Write for Catalog MB-110

VIBRATION ISOLATORS and SHOCK MOUNTS
To JAN-C-172A SPECIFICATIONS and TO ORDER

T. R. FINN & COMPANY, Inc.
Specialists in Vibration Control
333 JACKSON AVENUE, NEW YORK 54, N. Y.
Phone: CYpress 2-4192-3-4

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

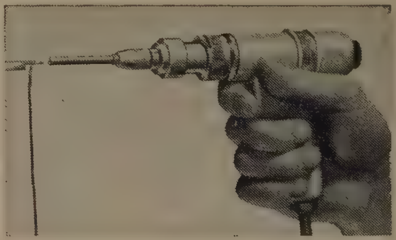
(Continued from page 136A)

Subminiature Triode

Raytheon Manufacturing Co., Special Tube Section, 55 Chapel St., Newton 58, Mass., announces a new low microphonic subminiature triode, Model Number CK6247 (formerly known as CK628). This type has a maximum noise output of 2.5 millivolts ac across 10,000 ohms in the plate circuit when the tube is subjected to vibrational acceleration of 15 g at 40 cps. The normal amplification factor rating is 60, and the mutual conductance rating 2500 μmhos with maximum allowable plate voltage of 275 volts. Data and further information may be obtained from Technical Information Service in Newton.

Wire-Wrap Tools

The Keller Tool Co., Grand Haven, Mich., announced the signing of a Patent License Agreement with **Western Electric Co., Inc.,** to manufacture and market wire-wrap tools.



During the past several years, Keller has designed and built air-powered wire-wrap tools. Development work on such tools has been in progress at the **Bell Telephone Laboratories, Inc.,** and tools are currently in use by the **Western Electric Co., Inc.,** the manufacturing unit of the Bell System.

Wire-wrap tools are used in the manufacture of telephone equipment. In some cases, the tools are replacing hand methods for wrapping small wires around terminals to provide a positive mechanical and electrical connection. They also eliminate the use of solder or any other method to mechanically hold the wire on the terminal. This method of joining wire and terminal is expected to find extensive application in the manufacture of radio and television sets, as well as telephone equipment. With the many hundreds of millions of terminal connections made annually, wire-wrap tools make available a great saving of manufacturing cost.

(Continued on page 140A)

dependable instruments

Heiland
DENVER

oscillograph recorders

FOR AIRCRAFT LABORATORY AND INDUSTRIAL APPLICATIONS

A-500
Compact Lightweight
12 channels

The A-500 Portable Recorder is being widely used in many diversified fields as it is designed for applications where space is at a premium. Although extremely compact, 6¾" x 9⅞" x 12¾", and lightweight, 33 lbs., the Heiland A-500 retains the versatility and embodies many of the features usually found only in much larger instruments. The features of the A-500 include four quick change paper speeds; precision time lines: trace identification; direct monitoring of galvanometer light spots. Paper width, 4"-100' long. Available for either 12 volt or 24 volt D.C. operation.

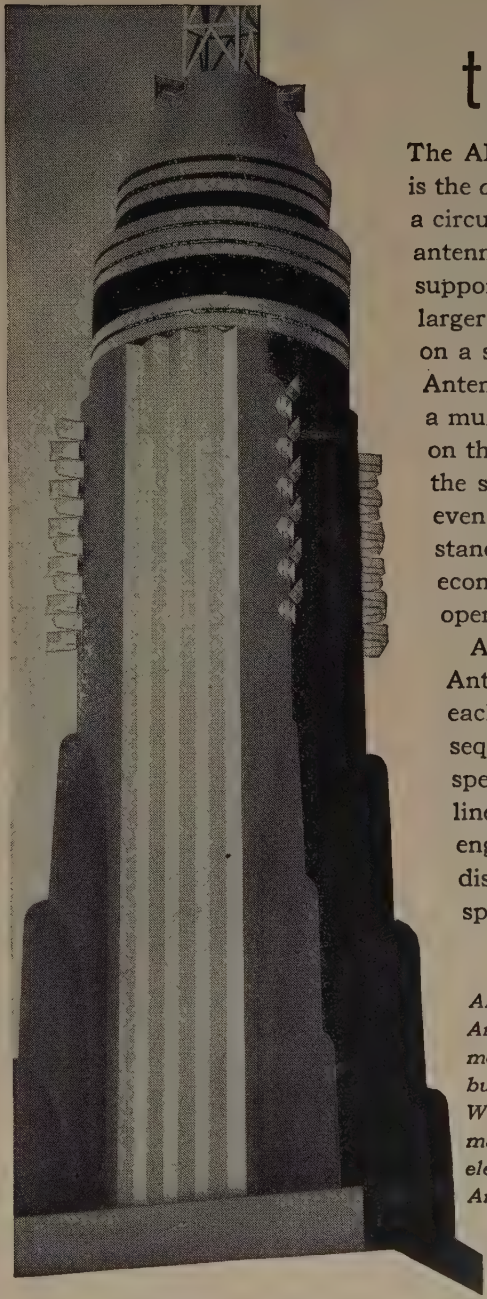
Write today for catalog of Heiland oscillograph recorders, galvanometers and associate equipment.

HEILAND RESEARCH CORP.
130 E. FIFTH AVE. • DENVER, COLORADO

ANDREW **"Skew"** ANTENNA*

for VHF and UHF

television



The ANDREW "Skew" Antenna is the *only* antenna which provides a circular radiation pattern from antenna elements placed around a supporting structure which is larger than a half wave-length on a side! With the "Skew" Antenna, it is possible to mount a multiplicity of TV antennas on the sides of tall buildings, on the sides of existing towers—even towers which also support a standard antenna on top. The economy offered by a joint operation of this type is obvious.

At present, the "Skew" Antenna is custom built for each installation and consequently general performance specifications cannot be delineated. However, ANDREW engineers will be glad to discuss its application to specific situations.

ANDREW four element "Skew" Antenna on the conical end of the mooring mast of the Empire State building, used as auxiliary by WJZ-TV. Lower on the mooring mast, artist's sketch shows the 48 element ANDREW "Skew" Antenna to be installed for WATV.

*Patents applied for

Andrew ANTENNA SPECIALISTS
CORPORATION • 363 EAST 75TH STREET, CHICAGO 19

TRANSMISSION LINES FOR AM-FM-TV-MICROWAVE • ANTENNAS • DIRECTIONAL ANTENNA EQUIPMENT • ANTENNA TUNING UNITS • TOWER LIGHTING EQUIPMENT more LISTENING COMFORT with lightweight TELEX headsets!!

THE ONLY PERSONAL PART OF ANY COMMUNICATION SYSTEM

*MONOSET
The modern styling and dependability, and superior performance of the TELEX Monoset have made old fashioned headphones obsolete. Magnetic.

*DYNASET
New dynamic under-chin TELEX Dynaset, with more highs and lows of both music and speech, is the delight of radio and TV monitors. Weighs only 1.25 oz.

*TWINSET
This lightweight 1.6 oz. TELEX Twinset pipes signal directly into the ear, blocking out background noises and banishing listening fatigue. Magnetic.

*EARSET
Sensitive TELEX Earset slips onto ear and is preferred by all who use single-phone headsets. Weighs only ½ oz. and leaves other ear free for phone calls or conversation.

Modern, lightweight, durable . . . Easily adjustable and built for hard usage, TELEX Headsets give top quality reception without the punishment of extra weight and pressure.

STANDARD OF THE WORLD FOR QUALITY HEADSETS

Telex produces headsets to manufacturers' specification

*Trade Mark

Commercial Communications · Electronic Laboratories
Office Transcribing Machines · Radio Monitoring
Telecasting · Amateur Radio · Record Stores · Theaters
Phone-Order Boards · Wired Music Installations

For complete information on any of the above headsets, write

TELEX, ELECTRO-ACOUSTIC DIV.
Department 3E • St. Paul 1, Minnesota
In Canada, ATLAS RADIO CORP., Toronto

TELEX
HEARING AT ITS BEST

R. F. CHOKES
Tiny-Rugged-Insulated
Immediate Delivery from Stock!
¼ to 150 microhenries

CONDOR RADIO MFG. CO.
2705 S. KRAMER
TUCSON, ARIZ.

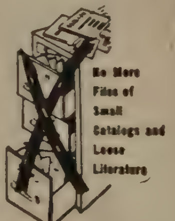
The right part when you need it for production or laboratory requirements

This permanent, hard cover Official Buying Guide of the electronic-TV parts and equipment industry with its comprehensive detailed index, eliminates the need for maintaining files of small catalogs and manufacturers' literature. RADIO'S MASTER catalogs 90% of TV and electronic equipment. Not merely part number listings—complete descriptions, specifications and illustrations written and compiled by each manufacturer. Enables you to make comparisons or substitutions right now!

- 1220 pages
- 80,000 items
- 8,000 illustrations
- 8″ x 11″—5 lbs.

Publisher's price $6.50—your price through your regular parts distributor $1.95

UNITED CATALOG PUBLISHERS, INC.
110 Lafayette St., New York 13


No More Files of Small Catalogs and Loose Literature

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 138A)

Power Supplies

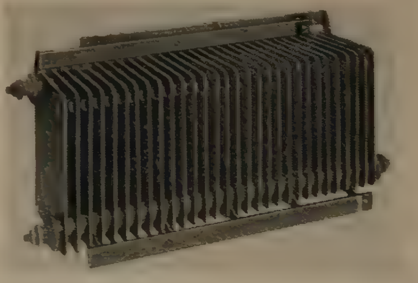
Kepco Laboratories, Inc., 131–38 Sanford Ave., Flushing 55, N. Y., has a new Model #700 dc voltage supply with excellent regulation, low ripple content and low output impedance.

The high voltage supply is continuously variable from 0 to 350 volts and delivers from 0 to 750 ma. In the range 30 to 350 volts the output voltage variation is less than ½ per cent for both line fluctuations from 105 to 125 volts and load variation from minimum to maximum current. The ripple voltage is less than 10 millivolts peak to peak.

Cabinet height 22¾ inches, width 21¾ inches, color gray, panel engraved. This unit is available delivering: 1.5 amperes—Model 710; 2.25 amperes—Model 720; and 3 amperes—Model 730.

Selenium Rectifier

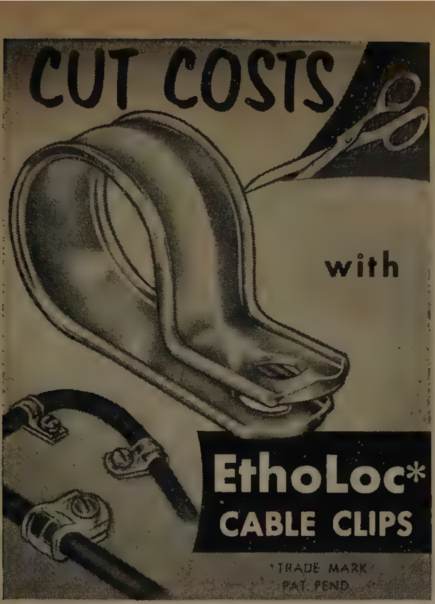
A new selenium rectifier cell rated 36 volts (RMS), designed especially for applications where size and weight are primary considerations, has been developed by **Federal Telephone and Radio Corp.,** 100 Kingsland Rd., Clifton, N. J., manufacturing associate of the International Telephone and Telegraph Corp.



Because the individual cells are rated at 36 volts RMS, a rectifier stack made up of these cells will not only withstand a higher reverse voltage, but will require fewer cells for the same voltage output. As a result, losses are proportionately less, and the efficiency of the stack is considerably increased.

The newly developed Federal rectifier unit is particularly well adapted for use in aircraft and in many types of military

(Continued on page 141A)



Made of tough, durable Ethyl Cellulose plastic. This cable clip will hold wires or groups of wires neatly and securely in position . . . no possibility of shorts or grounds. Only one fastener is required (screw, nail, rivet or eyelet) with these loop type supports.

Write for samples details, prices

ALSO MFRS. OF ALL NYLON CABLE CLIPS

WECKESSER CO.

5269 N. Avondale Ave. • Chicago 30, Ill.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 140A)

equipment. Its compactness and lighter weight also make it ideal for use in battery chargers and power supplies. Other features include rugged construction, long life, and a high operating temperature which results in less derating.

45 RPM Recording Discs

The Reeves Soundcraft Corp., 10 E. 52 St., New York 22, N. Y., manufacturers of recording discs and tape, has developed the first 45 rpm recording disc to be marketed commercially. The new disc has been designed for both professional and amateur use. The Soundcraft "45" fits any conventional recorder spindle and with the perforated center removed is ready for a 45 rpm turntable. The new discs are now in production and initial orders are being filled. List price of the Soundcraft "45" is $1.10.

Recent Catalogs

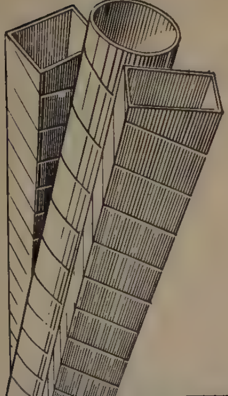
The Television Transmitter Div. of Allen B. Dumont Laboratories, Inc., 1500 Main Ave., Clifton, N. J., has released an up-to-date list of equipment and prices for complete television station planning. It is quite detailed and should be sufficient to completely price any type of installation.

(Continued on page 142A)

CLOSE-TOLERANCE CONSTRUCTION PLUS... QUALITY CONTROL... brings you the best in paper tubes

PRECISION

PAPER TUBES



Made of the finest dielectric kraft, fish paper, acetate, or combinations, PRECISION Paper Tubes are die-formed under heat and pressure. Uniformity, strength, and light weight are assured. High manufacturing standards and rigid testing result in maximum insulation, heat dissipation, and moisture resistant characteristics.

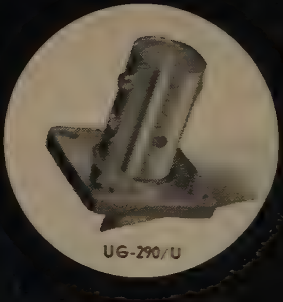
Available in any shape, length, I.D. or O.D. Finished to your exact specifications.

SEND TODAY FOR FREE SAMPLE AND REQUEST NEW ARBOR LIST OF OVER 1500 SIZES.

PRECISION PAPER TUBE CO.

2051 W. CHARLESTON ST. CHICAGO 47, ILL.
Plant No. Two, 79 Chapel St., Hartford, Conn.
Also Mfrs. of Precision Coil Bobbins

DICO BNC CONNECTORS



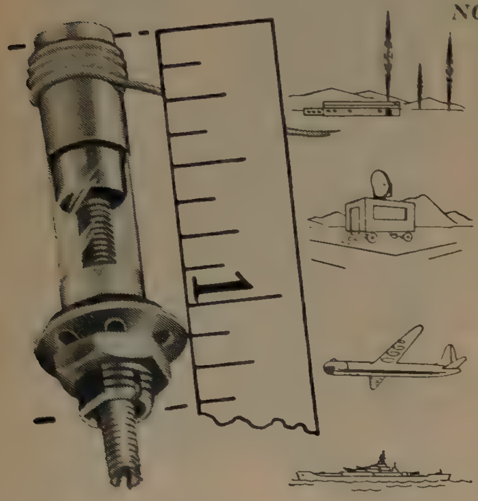
Manufactured with but one thought in mind . . . quality.

DICO

DIAMOND
MANUFACTURING CORPORATION
7 North Avenue, Wakefield, Mass.

JFD MFG. CO.
BROOKLYN 4, N.Y.
BENSONHURST 6-9200
world's largest manufacturer of tv antennas & accessories

leading manufacturers use
JFD PISTON TYPE VARIABLE TRIMMER CAPACITORS
in both civil and military equipment



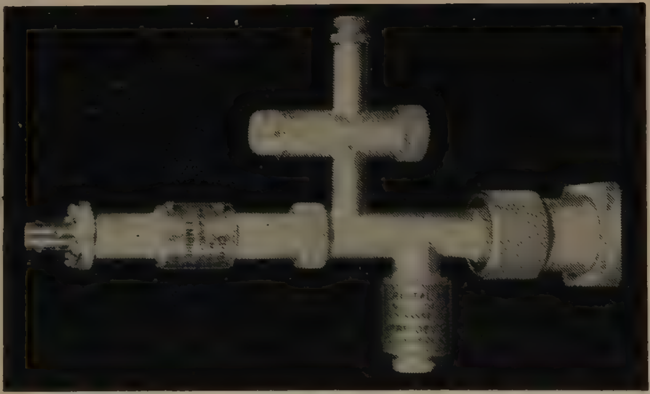
NO OTHER LIKE IT!

- Spring loaded piston made of special invar alloy having extremely low temperature coefficient of expansion.
- Silver band fused to exterior of precision drawn quartz or glass tube serves as stationary electrode.
- Piston dimensional accuracy is held to close tolerance maintaining minimum air gap between piston and cylinder wall.
- Approximately zero temperature coefficient for quartz and ± 50 P.P.M. per degree C. for glass units.
- "Q" rating of over 1000 at 1 mc.
- Dielectric strength equals 1000 volts DC at sea level pressure and 500 volts at 3.4 inches of mercury.
- 10,000 megohms insulation resistance minimum.
- Operating temperatures, −55 C. to +125 C. with glass dielectric. And −55 C. to +200 C. with quartz dielectric.
- Over 100 megohms moisture resistance after 24 hours exposure to 95% humidity at room temperature.

Write for Form No. 199

83-5378

COAXIAL CRYSTAL MIXER
BROAD BAND
FIXED TUNED



Broad Band Crystal Mixer Model CM107

INPUT VSWR: Better than 2 to 1, without adjustments, for all frequencies within the nominal frequency range.

LOCAL OSCILLATOR POWER REQUIREMENT: 10 Milliwatts. Oscillator injector is adjustable to accommodate large variations in oscillator power.

LOCAL OSCILLATOR VSWR: Better than 2 to 1 with any L. O. injector adjustment.

LOCAL OSCILLATOR REJECTION AT I. F. OUTPUT: Better than 30 DB.

MODEL	FREQ. RANGE IN MC
CM-107A	225 to 400
CM-107A1	300 to 530
CM-107A2	510 to 760
CM-107B	750 to 1210
CM-107C	1120 to 1700
CM-107D	1700 to 2600
CM-107E	2600 to 4000
CM-107F	4000 to 5600

EMPIRE DEVICES' expert engineering staff is available to give careful attention to your problems. Your inquiries are invited.

EMPIRE DEVICES, INC. 38-25 BELL BOULEVARD, BAYSIDE 61, N. Y.

MANUFACTURERS OF FIELD INTENSITY METERS • DISTORTION ANALYZERS • IMPULSE GENERATORS • COAXIAL ATTENUATORS

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 141A)

Synchronous Brake

Allard Instrument Corp., 30 Broad St., New York 4, N. Y., has released data on the second model B-2 Synchronous Brake. This is a device which provides a means of rotating a load at a desired synchronous speed without using a synchronous motor. An ac induction or any of the dc types of motors may be used.

The hollow shaft of the brake rotor is fastened to the motor shaft, and the brake stator is fastened to the face of the motor. The stator is fed the synchronizing frequency, the motor is started, and as it passes that synchronizing speed it is locked in step at that speed by the synchronizing torque of the brake.

The maximum synchronizing torque is 1.5 ounce-inches, maximum allowable speed is 15,000 rpm. Frequency range: 8-pole winding, 0 to 1,000 cps; 4-pole winding 0 to 500 cps; 2-pole winding 0 to 250 cps. Power input at full load and high speed is approximately 15 watts. Single phase winding, input voltage, up to 120 (to meet customer's specification).

High Speed Level Recorder

Recent electronic and mechanical design changes have resulted in improvements of the High Speed Level Recorder (Model HPL) produced by **Sound Apparatus Co.,** Stirling, N. J. The frequency response has been improved; furthermore, the sensitivity has been increased and can be adjusted from 7 to 12 millivolts. A new semi-automatic electronic damping is provided which controls the writing stylus and is particularly useful when the input potentiometers or writing speed are

(Continued on page 143A)

DeJUR

EXTERNAL PHASING

C-200

Potentiometers

- MULTIPLE GANGING
- INDIVIDUAL EXTERNAL PHASING
- POSITIVE INTERLOCK
- PRECISION MACHINED ANODIZED ALUMINUM CASE
- ADJUSTABLE TAPS WITHIN ± ½°

Designers are invited to submit their applications to DeJur engineers for recommendations and suggestions.

- 2" Diameter
- 4 Watts Fully Enclosed
- 10 to 200,000 Ohms Accuracy up to 1%
- Linearity up to 0.3%
- Non Linear Windings
- 360° (Continuous) Mechanical Rotation
- 320° Electrical Rotation
- Taps as Required
- High Resolution 1,000,000 Cycles Operational Life
- Precious Metal Contacts
- Low Torque 1 oz. inch
- Centerless Ground Stainless Steel Shafts
- Ball Bearings to Special Order
- Single or Ganged Units
- Servo Type Mounting or Single Hole Threaded Bushing
- Numerous Shaft Designs

WRITE FOR
BULLETIN 100-R

ELECTRONIC DeJUR U.S.A. INSTRUMENTS

DeJUR AMSCO CORPORATION
45-01 NORTHERN BOULEVARD, L. I. C. 1, N. Y.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 142A)

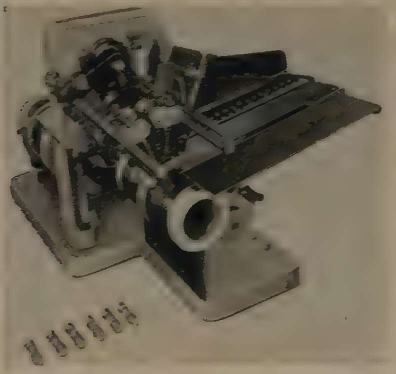
changed. The electronic chassis is an integral part of the recorder and can be easily substituted with circuits of different functions.

Mechanical changes have been made for a more convenient chart roll insertion and manual chart setting. Chart rewinding mechanism has been added. Knobs formerly protruding from the side of the instrument case have been eliminated.

Bulletin available upon request.

Fuse Marker

A new marking machine makes possible for the first time the printing of label information directly on cartridge-enclosed fuses, eliminating the need for paper labels. This machine is a product of **Markem Machine Co.**, Keene, N. H.



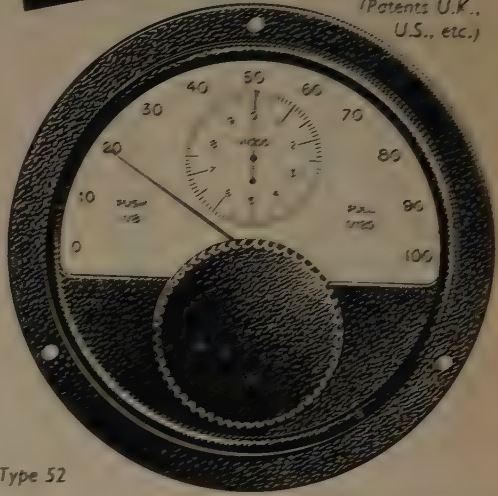
The 51A Machine is the result of a co-operative development with Underwriters' Laboratories, Inc., and with leading fuse manufacturers. It produces direct ink imprints which cannot "fall off" and are unaffected by moisture or ordinary chemical atmospheres. Label inventory and wastage problems are eliminated. Print is larger and colors simplify coding and identification. Use of this machine and the markings it makes on fuses meets with approval of Underwriters' Laboratories, Inc. Fuse manufacturers subscribing to UL testing service use a special recording die roll which counts the number of impressions made—maintaining the required UL control.

This new addition to the Markem line of machines for special marking applications will be followed by machines for marking fuses of all types.

(Continued on page 144A)

MICRODUAL
TWO-SPEED
PRECISION DRIVE

(Patents U.K., U.S., etc.)



Type 52

TWO SPEEDS · SINGLE CONTROL
FREE OF BACKLASH

Accuracy of scale reading 100%.

Coarse searching speed plus fine setting control.

Single control knob displaced axially to select the speed ratio.

Spring-loaded gears with automatic take-up of any wear or play between primary and secondary drives.

Pointers geared directly to centre spindle.

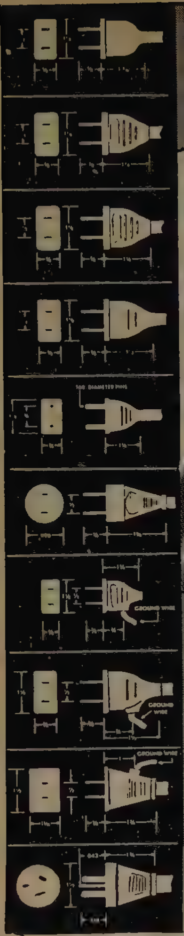
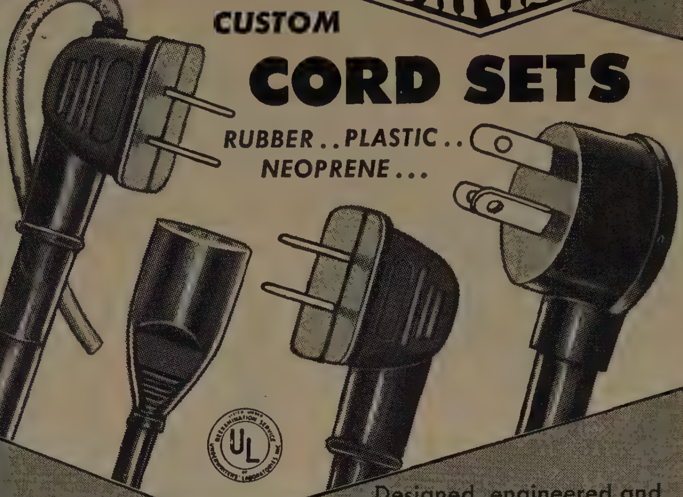
Security in operation: friction clutch obviates overdriving.

TYPE No.	NUMBER OF DIAL MARKINGS	EFFECTIVE SCALE LENGTH	SPEED RATIOS	
			COARSE	FINE
52	500	3.3 feet	1:8	1:25
63	500	3.3 feet	1:8	1:25
57	2,000	6.6 feet	1:15	1:200
56	2,000	6.6 feet	1:15	1:200
53	2,000	6.6 feet	1:15	1:200

We are specially organized to handle direct enquiries and orders from U.S.A.
Billed in dollars. Settlement by your check.

CABLE OR AIRMAIL TO-DAY

TRANSRADIO LTD
CONTRACTORS TO H.M. GOVERNMENT
138A CROMWELL ROAD, LONDON, S.W.7., ENGLAND
CABLES — TRANSRAD, LONDON



GLUTTONS for PUNISHMENT

CORNISH

CUSTOM

CORD SETS

RUBBER . . PLASTIC . . NEOPRENE . . .

Also "NOFLAME-COR" The Television Hookup Wire

Designed, engineered and produced for YOUR products! For a delicate "walkie-talkie" or a huge arc welding unit . . . put your wire problems up to CORNISH experts!

MADE BY ENGINEERS FOR ENGINEERS

CORNISH WIRE CO., INC.

50 Church St. New York 7, N.Y.

There is Always One Leader in Every Field

BODNAR INDUSTRIES, Inc.

leads in the field of

TRANSILLUMINATED PLASTIC LIGHTING PLATES

BECAUSE OF Quality • Uniformity • Performance

Design & Layout "Know-How Service"

Quantity Production Promptly

NEW YORK —19 Railroad Ave., New Rochelle (Home Office)
TEXAS —Jefferson Tower Building, Dallas
CALIFORNIA—11056 Cumpston St., N. Hollywood
CANADA —313 Montreal Trust Bldg., 67 Yonge St., Toronto

SPECIMEN PANEL MIL-P-7788 (AN-P-89) SENT ON LETTERHEAD REQUEST

MICROWAVE NOISE GENERATOR

FREQUENCIES AVAILABLE:

RG 48/U	2,600	to	3,950	megacycles
RG 49/U	3,950	to	5,850	megacycles
RG 50/U	5,850	to	8,200	megacycles
RG 51/U	7,050	to	10,000	megacycles
RG 52/U	8,200	to	12,400	megacycles

RG 48/U $385. RG 49-52/U $285.

SPECIFICATIONS:

Random Noise Output:—15.8 db all guides ±0.25 db above thermal noise at waveguide temperature of 32° C. Power Input:—30 Watts at 115 Volts, 50—60 cycle. Output Couplings—Standard JAN

COLOR TV TELECHROME INCORPORATED

THROUGH ADVANCED RESEARCH & DEVELOPMENT

88 MERRICK ROAD, AMITYVILLE, N. Y.

TELEPHONE: AMITYVILLE 4-4446

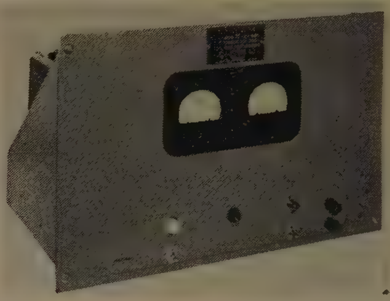
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 143A)

B-Supply

This B Supply was designed by **Sorensen & Co., Inc.**, 375 Fairfield Ave., Stamford, Conn., specifically for a test position requiring 300 volts dc. regulated, at the relatively high current of 1 ampere. A number of subsequent requests for similar instruments have resulted in their being made available as standard catalog items.

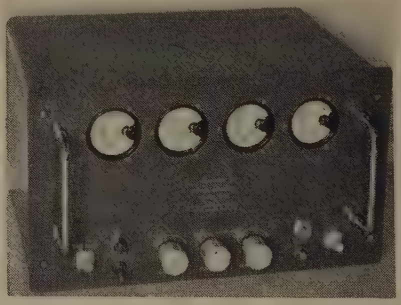


Designated as the Sorensen Nobatron, model E-300-1, the instrument has the following electrical specifications: Input is 105–125 volts at 50–60 cps; Output is adjustable from 297 to 303 volts dc at 0–1 ampere; regulation accuracy is ±1 per cent for line and load changes from zero to full load; ripple is 10 mv.

Full information on this instrument as well as other regulated dc sources and ac line regulators may be obtained by writing to the company.

Gated Counters

Digital Instrument Co., Inc., P.O. Box 1345, Coral Gables, Fla., has two new models (604 and 605) which are basic counting units containing an electronic decade counting unit, an input amplifier system, a gated circuit and a hold circuit with a variable period.



It is used with a time base generator to form a system for frequency, events, or revolution counting. When used with a fixed frequency source and controlled by on-off pulses, time interval measurements may be obtained. Maximum frequency is 100,000 counts per second. Count capacity of Model 604 is 4-digits, Model 605, 5-digits.

(Continued on page 145A)

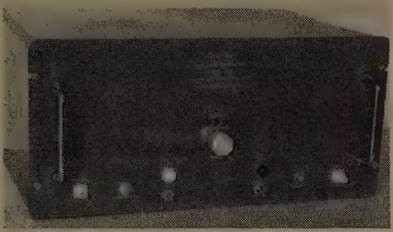
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 144A)

Time Base Generator

Digital Instrument Co., Inc., P.O. Box 1345, Coral Gables, Fla., has developed a Time Base Generator (Model 420) which is a precision source for balanced square waves, gate lengths and timing markers. It is designed to produce either marker pips or dc steps suitable for controlling gated circuits.



Fourteen gate lengths are available as follows: 0.05, 0.10, 0.50, 1.0, 5.0, 10.0 milliseconds, and 0.05, 0.10, 0.50, 1, 5, 10, 50, and 100 seconds. Square wave frequencies of 0.005, 0.01, 0.05, 0.1, 0.5, 1, 5, 10, 50, 100, and 500 cps, and 1, 5, and 10 kc. Frequency stability is 1 part in 100,000. Precisely balanced square waves, 50/50 duty cycle. The output is direct coupled.

(Continued on page 146A)

Direct Coupled
Wide Band Amplifier

A unique instrument to amplify small DC and high frequency potentials found in research in such fields as physiology, geophysics, strain measurements and analog computing.

Response Frequency response, flat ±2% to 20,000 cps, is usable to at least 100 kc.

Gain Differential voltage gain of 100,000 stabilized by negative feed back to ±1%.

Noise Less than 10 microvolts of noise at widest bandwidth with input shorted.

Drift Drift is less than 5 microvolts per minute with the AEL 351 Power Supply.

Input Input impedance is 100 meg. with less than 0.1 microamp. grid current.

Output Low output impedance directly drives oscillographs, recording instruments.

Write for detailed specifications and catalog.

American Electronic Laboratories
INCORPORATED
641 Arch Street, Philadelphia 6, Pa.

High Impedance Millivolt Measurements Above 5 MC

Below the input voltage level of 25 mV germanium diodes and other crystal rectifiers are nearly square law detectors. When combined with a high impedance vacuum tube millivoltmeter for DC, having 1 mV full scale deflection at 6 megohms input impedance, these crystal rectifiers can be used as "pseudo-thermocouples" for high impedance millivolt measurements at input wattage levels substantially lower (microwatts) than those of ordinary heater type thermocouples (milliwatts). This is particularly useful for mV measurements above 5 MC since little in the way of instruments has been available in those higher frequency ranges, so far.

It Measures Where Others Fail

Millivac MV-18B RF-mV-Meter

- Measures RF signals down to a single mV and DC down to 50 microvolts.
- Wide Frequency Range (1 MC to 200 MC flat within 10% directly calibrated. Useful up to 2,500 MC with calibration chart).
- Minimum Circuit Loading (new "MINIMUM CAPACITY PROBES" have 1.0, 1.5 and 2.8 MMF rated input capacities).
- Wide Voltage Range (RF 10mV to 1,000 V, directly calibrated, 1mV to 10 mV by chart—DC 50 microvolts to 10 mV, directly calibrated).
- Square Law Dial For Vacuum Thermocouples and High Impedance "Pseudo-Thermocouple" Measurements.

MILLIVAC INSTRUMENT CORPORATION
P.O. BOX 997, Schenectady, N.Y.

One Call for All...
HUDSON RADIO & TELEVISION CORP.
AUTHORIZED DISTRIBUTOR
RCA

RCA TEST EQUIPMENT
TUBES • PARTS • BATTERIES

NEW! 5" OSCILLOSCOPE WO-88A
High Gain • Wide Band • Direct Coupled

Response flat from dc to 100 Kc; within —3 db at 500 Kc; within -10 db at 1 Mc. Excellent square wave response with negligible tilt and over-shoot. Vertical deflection sensitivity 25 rms millivolts per inch. Direct-coupled push-pull, two stage vertical amplifier. Frequency compensated, voltage-calibrated attenuators. 5" CR tube with graph screen scaled directly in peak-to-peak voltage. Overall input resistance 10 megohms shunted by 9.5 uuf with WG-216B Low Capacitance Probe. "Plus" and "minus" sync, 1-volt peak-to-peak calibrating voltage.

Complete with Matched Probes and Cables Price $159.50

COMPLETE STOCKS ALWAYS ON HAND! For fast service on RCA TUBES, TEST INSTRUMENTS, BATTERIES, PARTS . . . Call Hudson your complete, dependable source!

FREE! NEW 1953 HUDSON CATALOG
With Latest JAN Cross-Reference GUIDE

Everything in electronics at your fingertips in this greatest of all 1953 HUDSON CATALOG! Over 196 pages of Radio, TV, Tubes, Test Instruments . . . all standard electronics equipment for industry. The most complete buying guide of its kind PLUS the latest JAN CROSS-REFERENCE GUIDE with complete listings of fully approved JAN type components with comparative cross-reference interchangeability charts that save endless hours of catalog searching.

Get Prompt Delivery of Everything You Need From HUDSON . . . Complete Stocks of All Standard Electronics Equipment and Fully Approved JAN Type COMPONENTS.

HUDSON RADIO & TELEVISION CORP.
Send for your FREE Catalog today! Dept. T-1
48 WEST 48th ST. • 212 FULTON ST.
New York 36, N. Y. • Circle 6-4060 • New York 7, N. Y.

LARGE OR SMALL
SQUARE, ROUND OR RECTANGULAR
Coil-Proved

PARAMOUNT
Spiral-Wound
PAPER TUBES

Lengths from ½" to 30"
Inside Perimeters, .450" to 25"

PARAMOUNT Paper Tubes facilitate coil winding—insure coil accuracy and stability. Proved by use, they have become standard with leading manufacturers of electrical, radio and electronic products. Here you are sure to obtain the exact size and shape you need for coil forms and other uses . . . from stock arbors, or specially engineered to your specifications. *Hi-Dielectric. Hi-Strength.* Kraft, Fish Paper, Red Rope, or any combination, wound on automatic machines. Tolerances plus or minus .002" • *Also* Shellac Bonded Kraft Paper Tubes for absolute moisture resistance.

WRITE ON COMPANY LETTERHEAD FOR STOCK ARBOR LIST OF OVER 1000 SIZES

PARAMOUNT PAPER TUBE CORP.
617 LAFAYETTE ST., FORT WAYNE, IND.
Mfrs. of Paper Tubing for the Electrical Industry Since 1931

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 145A)

Recent Catalogs

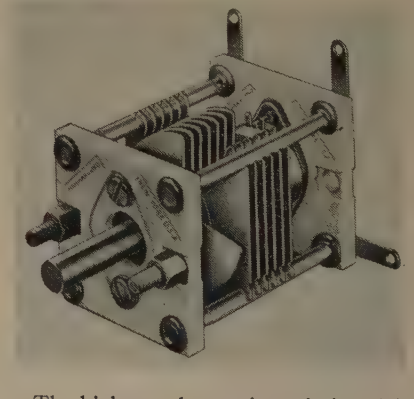
Featuring typical examples of specialty transformers for airborne electronic equipment, a new 2-color brochure, complete with illustrations and descriptions, has just been issued by **Goslin Electric & Manufacturing Co., Div. The Goslin Corp.**, Dept. AT, 2121 W. Olive St., Burbank, Calif.

The brochure outlines applications of transformers custom-engineered especially for airborne radar, gyro and communications equipment and describes construction features, electrical characteristics, dimensions, weights and specifications. Transformers featured meet or surpass exacting Military and Civilian aircraft specifications and include the following types: hermetically sealed and open framed units of small size and light weight; Pulse, Single-Phase to Three-Phase, Filament, Power, Charging Reactor (Choke), Bridge, Audio Frequency, Filter Choke (Reactor), etc.

Brochure also includes illustrations of modern engineering, development, testing and production facilities. Brochure can be obtained by writing.

High-Speed Capacitor

A butterfly-type variable capacitor capable of continuous operation at speeds as high as 3,200 rpm is now available from the **Hammarlund Mfg. Co., Inc.**, 460 West 34 St., New York 1, N. Y.

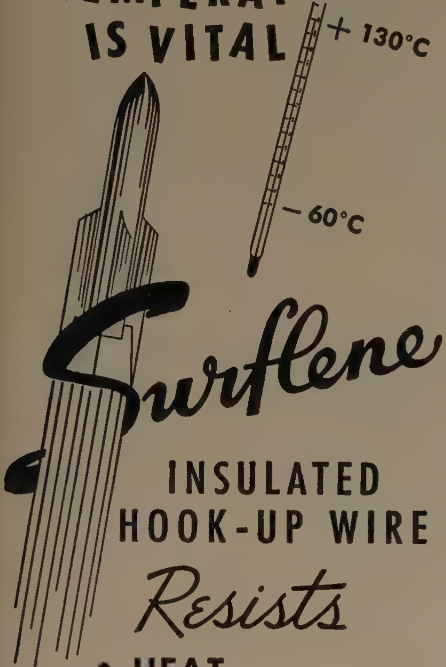


The high-speed capacitor, designed for sweep circuits and other applications requiring alternating capacity values, eliminates rotor contact springs and uses commercial ball bearings in addition to a novel alignment and end-thrust take-up device. Soldered brass rotor and stator assemblies nickel or cadmium plated, are used.

Units are available with series effective capacity values ranging from 5.4 to 17.0 $\mu\mu$f nominal. Air gap between plates is 0.030 inches nominal. Outside dimensions of each silicone-treated steatite base is $1\frac{3}{8} \times 1\frac{3}{8}$ inches.

(Continued on page 148A)

WHERE RESISTANCE TO HIGH AND LOW TEMPERATURES IS VITAL



INSULATED HOOK-UP WIRE

Resists

- HEAT
- FUNGI
- ABRASION
- CHEMICALS

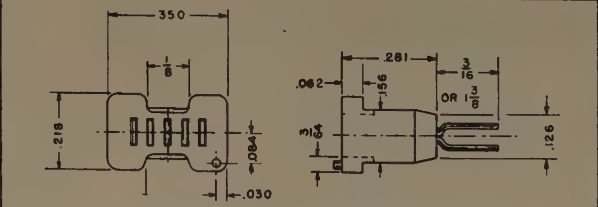
"Surflene", extruded monochlorotrifluoroethylene, has high insulation resistance, dielectric strength and outstanding resistance to heat, abrasion, most chemicals and concentrated acids, including fuming nitric acid. It is non-inflammable and inert to fungi. It is especially designed for hermetically sealed and water-proof equipment and for high temperatures encountered in power supply and continuous duty apparatus. Also available in multi-conductor cables.

"Surflene" is available in thirteen colors — red, orange, yellow, pink, light and dark green, blue, gray, tan, brown, black, white and clear.

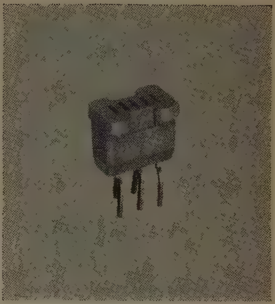
Write our Engineering Service TODAY for technical assistance.

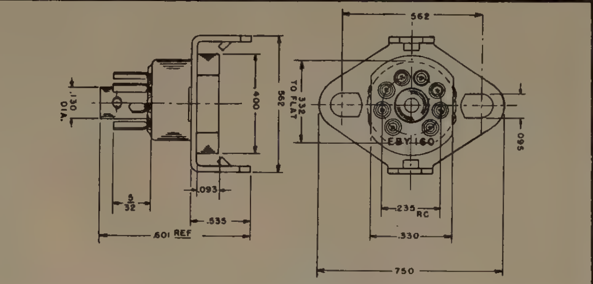
Surprenant
MANUFACTURING COMPANY
199 WASHINGTON ST., BOSTON 8, MASS.

NOW the EBY sub-miniature completes the EBY socket line!

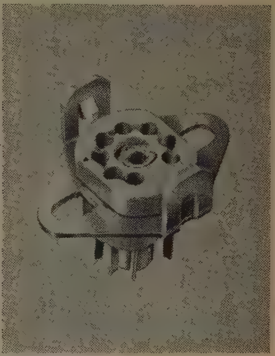


SUB-MINIATURE RECTANGULAR
5 pin available. Write for particulars on 6, 7, and 8 pin. Material data below.

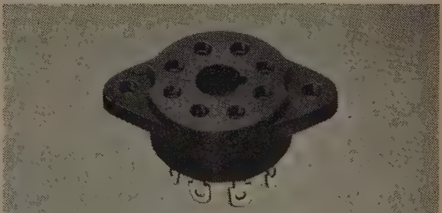




SUB-MINIATURE ROUND
8 pin now available. Material data below.



MINIATURE SOCKETS
Complete line of 7 and 9 pin; R.M.A. and JAN types.



OCTAL SOCKETS
Complete line of R.M.A. and JAN types, plus all-molded for high voltage TV circuits.

Eby sub-miniatures complete the standard Eby socket line. Here are the details:

Contacts: Beryl. copper silver plated, tin dipped, or gold flash over silver plate.
Body: Low-loss mica-filled phenolic.
Saddle: Brass, nickel plated.

Deliveries on all Eby components are good. Phone, write or wire.

Need an Eby catalog? Just ask for one.

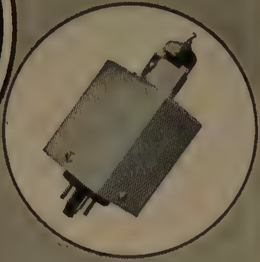
HUGH H. EBY INC.

4702 Stenton Ave., Philadelphia 44, Pa.

PATENT PENDING
Socket-Turrets for most tube types will carry a wide variety of circuit elements.

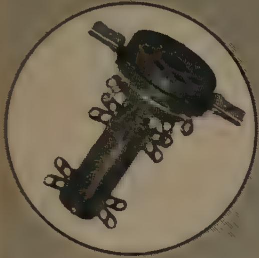
Vector
SOCKET-TURRETS

Plug-Ins of many sizes with sockets and plugs as desired provide great flexibility in circuitry



UNIQUE

Unitize those tricky circuits for quick change or repair, compactness, top performance, ease and economy of fabrication. Hundreds of experimenters and designers have found the answer they have been looking for in the Socket-Turret Method of construction. New and improved models for the most exacting applications are now available. Let us tell you more about them. Send for catalog.



REPRESENTATIVES
B. B. Taylor Co., 150 Broadway, N.Y. City
Anderson Sales, 172 State St., Boston
R. J. Magnuson, 2323 W. Devon, Chicago
D. H. Ross Co., 1355 Market, San Francisco

Vector Electronic Co.
3352 SAN FERNANDO RD., LOS ANGELES 65

MICROLAB

FIXED PAD ATTENUATORS

μ LAB

Frequency Range	D.C. to 3000 MC
Attenuation	1 to 60 db.
Power Rating	One Watt
Impedance	52 ohms
VSWR 1000 MC	1.10
VSWR 2000 MC	1.15
Connectors	Type N

PRICE
$20.00
to
$30.00

Some of Our
OTHER PRODUCTS
- LOW PASS FILTERS
- HIGH PASS FILTERS
- COAXIAL TERMINATIONS
- POWER LINE FILTERS
- FREQUENCY MULTIPLIERS

WRITE TODAY
For Our
Complete
Catalog

coaxial components and test equipment
μ LAB
MICROLAB

Phone: SOUTH ORANGE 2-7422

MICROLAB 301 SOUTH RIDGEWOOD ROAD
SOUTH ORANGE, NEW JERSEY
COAXIAL COMPONENTS and TEST EQUIPMENT

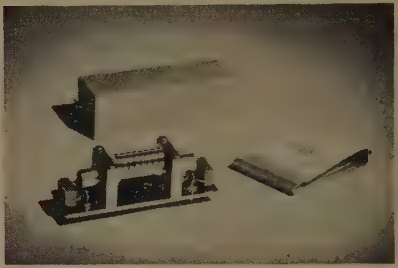
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 146A)

Mechanical Filter

The Collins Radio Co., Cedar Rapids, Iowa, recently announced the development of a Mechanical Filter. This unit is being offered to the industry as a component and, in addition, Collins is incorporating these filters in their new transmitter and receiver designs. More rigid control of transmitter side-band radiation as well as rejection of adjacent channel interference in receivers is accomplished by this filter.



The filter is a magnetostrictively driven unit for intermediate frequency application and is composed of three sections; the input transducer, the resonant section, and the output transducer. Input and output sections are identical and function to convert the electrical signal to a mechanical form and vice versa. In the resonant section, disks composed of special alloy metal have a very sharp resonance and excellent frequency stability. By means of magnetostrictive action, mechanical vibrations are converted into a varying magnetic field. A coil intercepts this field and supplies the output voltage. The entire unit is housed in a hermetically sealed case smaller in size than a normal intermediate transformer.

Recent Catalogs

470 new items are covered by **Centralab, Div. Globe-Union, Inc.,** 900 East Keefe Ave., Milwaukee 1, Wis., in a new industrial and distrubutor stock catalog number 28. The book has 32 pages and covers five product divisions; variable resistors, ceramic capacitors, rotary and level switches, printed electronic circuits, and steatite insulators.

A few of the items included in Catalog 28 are: A new line of miniature ceramic rotary switches; Disc capacitors with molded insulation;—all values; Expanded and improved "Blue Shaft" and "Adashaft" control lines; New capacitor items: Ceramic standoffs, feed-throughs, button-type capacitors, 1600 volt buffers, and miniature trimmers.

Central Catalog 28 will keep anyone in radio or electronics up to date with the latest information on components from the pioneer and leader in that field.

IRE

Invites You to-

The 41st Annual Meeting
of the
Institute of Radio Engineers

The opening meeting of the IRE National Convention is the annual meeting of the Institute. This year's innovations offer special interest to members. The feature speaker will be our Director, William R. Hewlett, Vice President of Hewlett-Packard Company. The incoming president's gavel will be presented to James W. McRae. Nine Charter Member Pins will be given, honoring original members and commemorating the three founders of the Institute. Alfred N. Goldsmith, John V. L. Hogan, and the family of R. H. Marriott will be present. Reports of the IRE Officers, and of the progress of the IRE will be presented.

March 23-26, 1953 at New York City
Waldorf Astoria Hotel and Grand Central Palace

- **The Get-together Cocktail Party, Monday, March 23rd at 6 P.M. Grand Ballroom**
- **IRE Annual Banquet is on Wednesday, March 25th in the Grand Ballroom of the Waldorf-Astoria Hotel**

The Radio Engineering Show

Introduced as a part of the IRE Convention in 1930, this will be the 21st Radio Engineering Show, and the eighth in Grand Central Palace. This year the show exhibits occupy all four floors, and 405 different firms will utilize over 58,000 sq. ft. of exhibit space to show products representative of over 90% of the radio-electronic manufacturing capacity of this country. The exhibitors' list is the "who's who-blue book" of a gigantic industry.

As a fore-taste of the great Radio Engineering Shows of the future, which will probably be laid out in greater areas and on fewer floors, the third and fourth floors this year present grouping of exhibits of related interest. There are centres for "audio" and "nucleonics," and avenues for "components," "instruments," "production," "military radio" and "computers."

Many of the newer firms in the industry are using the spacious aisles and special interest centres of the fourth and third floors to show you what is new in radio-electronic product development. The progress of components, instruments and tools presented to you for swift and easy assimilation in the exhibits is one of the most practical and interesting engineering information services the IRE offers its members and friends.

43 Technical Sessions
—about 220 Papers

The 19 Professional Groups of the IRE, serving with special representatives on the Technical Papers Committee, have seen to it that the choicest of new developments in all phases of radio-electronic engineering progress are presented in the technical sessions. Skill and planning have been necessary in selecting the "timely top half" of all the excellent papers offered. Organization into related groups adds to the convenience of attending members.

The fact that eleven special symposia have been organized by the professional groups greatly increases the value of the technical sessions. These four days are much like eleven big conventions rolled into one, for the time and travel economy of the IRE membership.

The sessions will be in the Grand Ballroom, The Jade Room, and The Astor Gallery in the Waldorf-Astoria Hotel, in the Moderne Room of the Belmont Plaza directly across Lexington Avenue, and in the Gold and Blue Halls on the third floor of Grand Central Palace, two blocks south. The full program of papers will appear in the March issue of "Proceedings of the I.R.E." and in a letter to members mailed in January.

Registration for IRE Members is $1.00, and non-members is $3.00. IRE Members will do well to act promptly on their hotel reservation form, sent with the invitation letter, and should save and use the IBM registration card which will be mailed to them in February. There is no advance registration, but reservations for social events and hotel rooms should be made now.

IRE Meetings and Exhibits Speed Electronic Progress!

Proceedings of the I.R.E. February, 1953, Vol. 41, No. 2. Published monthly by the Institute of Radio Engineers, Inc., at 1 East 79 Street, New York 21, N.Y. Price per copy: members of the Institute of Radio Engineers $1.00; non-members $2.25. Yearly subscription price: to members $9.00, to non-members in United States, Canada and U.S. Possessions $18.00; to non-members in foreign countries $19.00. Entered as second class matter, October 26, 1927, at the post office at Menasha, Wisconsin, under the act of March 3, 1879. Acceptance for mailing at a special rate of postage is provided for in the act of February 28, 1925, embodied in Paragraph 4, Section 412, P. L. and R., authorized October 26, 1927.

Table of Contents will be found following page 64A

REXOLITE 1422

(FORMERLY G. E. TEXTOLITE 1422)

THE *BETTER* PLASTIC FOR U. H. F. INSULATION

BECAUSE OF:

- outstanding electrical properties
- superior machinability
- high heat resistance
- dimensional stability and extremely low initial cost

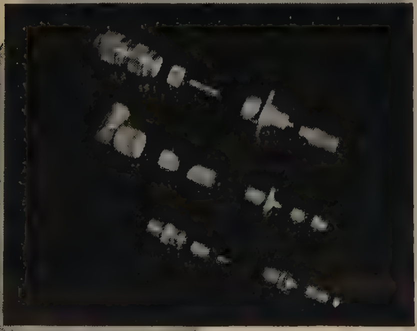
Rexolite 1422 has been specifically designed and developed to meet the growing need for a lightweight — low cost U. H. F. insulating material.

Rexolite 1422 is available for immediate delivery as centerless ground rod in any diameter up to 1". Also cast in larger diameter rods and sheets.

Meets JAN-P-77 and MIL-P-77A specifications.

The unusual chemical inertness and physical properties of Rexolite 1422 allow its use where other materials fail.

***For use in:* connectors, coaxial connectors, waveguide, antennas, leads and spacers, spreaders and air wound coil supports, coil forms.**



Write today for technical bulletins and samples. Our engineering staff is always at your disposal.

Manufacturers of Non-strip wire, High Temperature Electrical Tubing and other extruded plastic products.

THE REX CORPORATION

HAYWARD ROAD WEST ACTON, MASS.

Meetings with Exhibits

RADIO—ELECTRONICS
A Preview of Progress
I.R.E. CONVENTION
RADIO ENGINEERING SHOW

405
Exhibits

WALDORF-ASTORIA HOTEL
GRAND CENTRAL PALACE
NEW YORK CITY
MARCH 23-26 1953

Δ

March 23, 24, 25 & 26, 1953

Radio Engineering Show Grand Central Palace, New York City

Exhibits Manager: Wm. C. Copp, 303 W. 42nd St., New York 36, N.Y.

Δ

April 11, 1953

NEREM—New England Radio Engineering Meeting, University of Connecticut, Storrs, Conn.

Exhibits: H. W. Sundius, The Southern New England Tel. Co., 227 Church St., New Haven, Conn.

Δ

April 18, 1953

Spring Technical Conference of the Cincinnati Section, Cincinnati, Ohio

Exhibits: R. W. Lehman, The Baldwin Co., 1801 Gilbert Ave., Cincinnati 2, Ohio

Δ

May 11, 12 & 13, 1953

National Conference on Airborne Electronics Hotel Biltmore, Dayton, Ohio.

Exhibits: Paul Clark, 120 West Second St., Dayton 2, Ohio.

Δ

August 19, 20, 21, 1953

1953 Western Electronics Show and Convention, Civic Auditorium, San Francisco, Calif.

Exhibits: Heckert Parker, 1355 Market St., San Francisco 3, Calif.

Δ

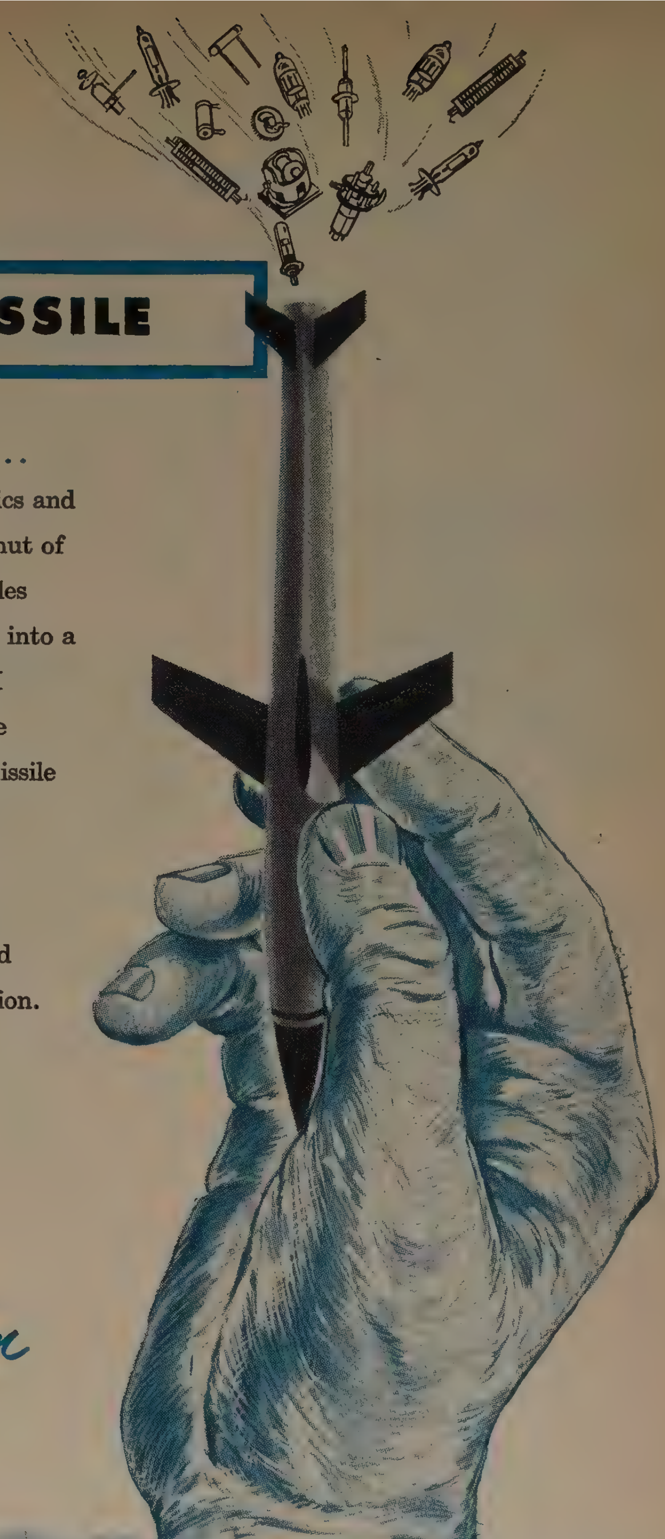
September 28, 29 & 30, 1953

National Electronic Conference Hotel Sherman, Chicago.

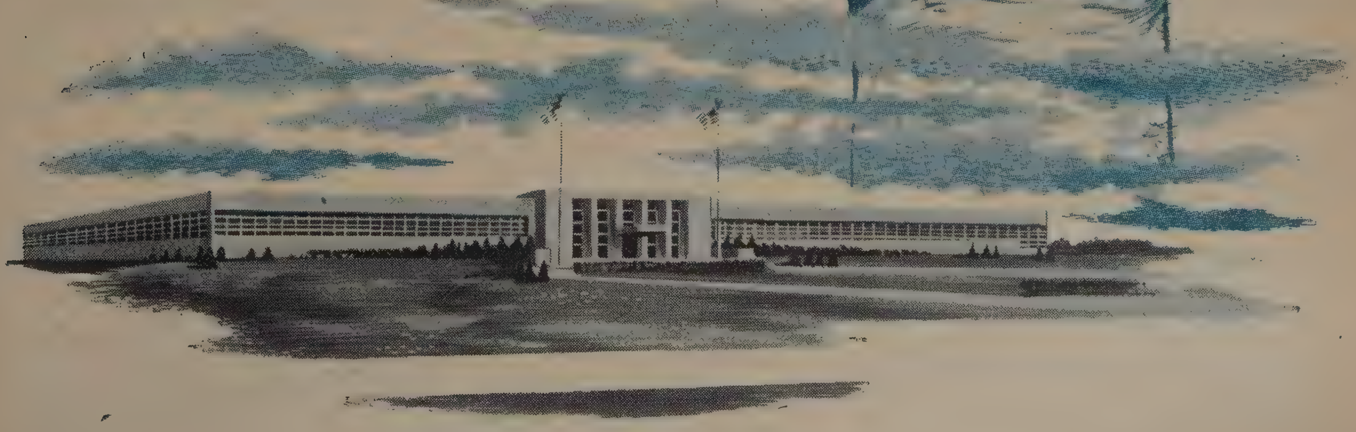
Exhibits: Orville Thompson, c/o DeForrest's Training Inc., 2735 N. Ashland Ave., Chicago 14, Ill.

MAKINGS OF A MISSILE

Many things go into the Makings of a Missile . . . electronic tubes, rocket motors, metals, plastics and creative engineering talent running the whole gamut of the engineering specialties. Fairchild's Guided Missiles Division has this engineering talent—welded into a team by experience going back into World War II when Fairchild was prime contractor for one of the earliest guided missiles. For its experienced missile engineering and production organization, which has produced missiles for all three branches of the Armed Services, Fairchild recently completed this country's first privately built plant devoted exclusively to missile development and production.



ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Guided Missiles Division
Wyandanch, L. I., N. Y.
Other Divisions: Aircraft Division, Hagerstown, Md.
Engine Division, Farmingdale, N. Y.

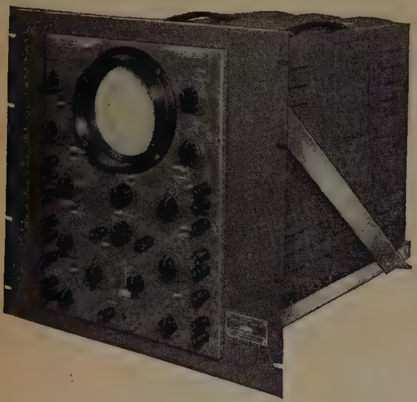


NEWS and NEW PRODUCTS

February 1953

Rack Mounting Adapter for Oscillographs

A new rack mounting adapter for use with Du Mont Types 303, 303-A, 303-AH and 322 cathode-ray oscillographs is now available from the **Instrument Div., Allen B. Du Mont Laboratories, Inc.,** 1500 Main Ave., Clifton, N. J. The Adapter is designed as the Type 2598.



The adapter has been designed to provide a rigid mount for the instrument and to present a neat, yet completely accessible unit in standard 19 inch relay racks. The Type 2598 bolts to the rack frame and provides a sufficiently large front opening to permit all but the front panel of the cathode-ray oscillograph to pass through. Channels are fastened to the Type 2598 Adapter to provide support for the instrument. Provision has also been made for the bolting of the instrument cabinet to these channels so that the entire relay rack may be moved with the instrument in place.

The Type 2598 is shipped dis-assembled with simple instructions. Price is $45.00. Complete details are available upon request.

Two High-Voltage Rectifier Tubes

Two new high-vacuum diodes, types 6102 and 6103, for industrial use in high-rectifier applications are now available from the **Westinghouse Electronic Tube Div.,** Dept. T-390, Box 284, Elmira, N. Y.

Type 6102 is designed for use in rectifier applications involving peak inverse voltages up to 40 kv. Intended for oil-immersed operation, the maximum average current is 150 ma and peak current is 900 ma. It is 2 13/16 inches long and 2 3/16 inches in diameter.

Type 6103 is designed for use in rectifier applications involving peak inverse voltages up to 20 kv. 6103 is provided with an integral radiator for forced-air cooling. Maximum average current is 150 ma and peak current is 900 ma. The tube is 2 15/16 inches long and 2 3/16 inches in diameter. It weighs 8½ ounces.

For further information, write Westinghouse Electronic Tube Div.

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

Radial Beam Power Tetrode

Eitel-McCullough, Inc., San Bruno, Calif., manufacturer of electronic transmitting vacuum tubes, has announced the development of a radial-beam power tetrode designed for use in commercial and military aircraft and other vehicular operation.

The new tube, Number 4X150D, has a heater rating of 26.5 volts at 0.57 ampere which makes it ideal for use in 28 volt electrical systems.

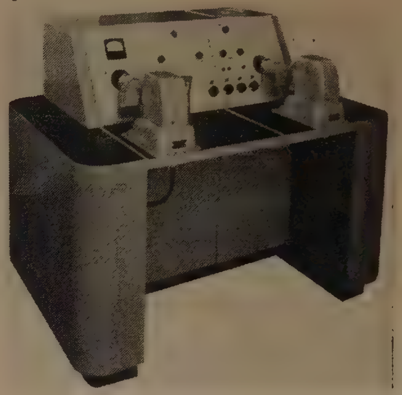
Size (2½ inches in length) and shape of the new tetrode is identical to the firm's Eimac 4X150A and can be used with the Eimac 4X150A air-system socket. Like the 4X150A it is used as an oscillator, amplifier, or frequency multiplier into uhf, and has a plate dissipation rating of 150 watts in Class-C telegraphy or FM telephony service.

Further information about the 4X150D tetrode can be obtained by writing to the Application Engineering Dept.

Improved Scanner

Federal Telecommunication Labs., Inc., 500 Washington Ave., Nutley, N. J., research associate of the International Telephone and Telegraph Corp., has announced the development of an improved version of its Poly-Efex Scanner (FTL-03A) for television station application. Incorporating advanced circuits and expanded operational features, the Scanner now allows a single operator to take complete charge of a station's program sources.

The Poly-Efex Scanner, basically a dual flying spot scanner, has, in addition to its two self-contained slide sources, a four-channel video switcher, and a special effects section. This special effects or montage section permits a variety of picture presentations, such as "split-screens," corner or center insertions, superimposed patterns, of any two signals, plus automatic or manual fades, lap dissolves, and wipes.



The two high-resolution slide sources may be fed by automatic slide magazines that hold as many as 72 slides which may be fed in or out of sequence. In addition, a preview output has been added to the usual line and monitor outputs for adjusting the next signal to appear on the program line.

An integral gamma correction circuit has been built into the unit to compensate for the non-linearity of the raster produced by the cathode-ray tube.

Miniature Continuously Variable Delay Line

Advance Electronics Co., P.O. Box 574, Passaic, N. J., has a new Type 507 miniature delay line capable of providing continuously variable time delay from zero to several hundreds of millimicroseconds. By means of a mathematical method invented by Advance, the amount of equalization was made exactly equal to its correct optimum value. As a result, the transmission characteristics are superior to those of other commercially available delay line of distributed, or lumped-parameter type. From the purely physical standpoint, the small size and weight of this unit make it particularly suitable for incorporation in any instrument where continuously variable time delay is needed. Other outstanding features include fast rise time, good stability, hairline accuracy, and complete freedom of time jitter.

Time delay is continuously variable from 0 to 0.8 microseconds. Rise time is 0.0012 t microseconds, where t is the amount of delay in millimicroseconds. Characteristic impedance is 390 ohms nominal. The attenuation in db per 100 millimicrosecond delay is essentially zero below 3 mc, 0.5 at 8 mc, 1 at 15 mc.

Size: 1 inch deep, 4 inches long, 4 inches high. Weight is 14 ounces.

(Continued on page 100A)

...has everything you need for PRINTED CIRCUITS

First to provide Tubes and Transistors that are correctly designed for quick, efficient printed circuit assembly. For the ultimate in portable performance, combine Raytheon's high-efficiency, filamentary Subminiature Tubes with Raytheon's Junction Transistors.

Subminiatures		Filament Volts	Filament Ma.	Plate Volts	Screen Volts	Grid Volts	Plate Ma.	Screen Ma.	Mutual Cond. Umhos.	Voltage Gain	Plate Resis. Meg.
1AG4	Output Pentode	1.25	40	41.4	41.4	−3.6	2.4	0.6	1000	35†	0.18
1AH4	RF Pentode	1.25	40	45.	45.	0	0.75	0.2	750		1.5
1AJ5	Diode-Pentode	1.25	40	45.	45.	0	1.0	0.3	425	50	0.3
1V6*	Mixer-Pentode	1.25	40	45.	45.	0	0.4	0.15	200**		1.0
	Osc.-Triode			45.	—	Rg = 1 meg.	0.4	—	550		
1AK4	RF Pentode	1.25	20	45.	45.	0	0.75	0.2	750		1.5
1AK5	Diode-Pentode	1.25	20	45.	45.	5 meg.	0.5	0.2	280	40	0.4

†Power Output — milliwatts **Conversion Conductance

***Type 1V6 is a high performance, low battery drain converter. Note the comparison with 1R5 using 45 volt supply.**

	1V6	1R5
Total Cathode Current (ua)	960	2750
Conversion Conductance (umhos)	200	235
Plate Resistance (megohms)	1.0	0.6
Conversion Gain (load = 175K)	30	32
Equiv. Noise Resistance (ohms)	70K	180K

PNP JUNCTION TRANSISTORS

(Average Characteristics at 30° C)

	CK721	CK722
Collector Voltage (volts)	–1.5	–1.5
Collector Current (ma.)	–0.5	–0.5
Base Current* (ua.)	– 6	– 20
Current Amplification Factor*	40	12
Power Gain* (db)	38	30
Noise Factor* (1,000 cycles) (db)	22	22

*Grounded Emitter connection

RAYTHEON®

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division — for application information call

Newton, Mass. Bigelow 4-7500 ● Chicago, Ill. NAtional 2-2770 ● New York, N. Y. WHitehall 3-4980 ● Los Angeles, Calif. Richmond 7-5524

RAYTHEON MAKES ALL THESE!

RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES

AMPHENOL

AMPHENOL builds to the future of ELECTRONICS . . .

Electronics, tomorrow's industry today, has fully come of age! As industrial, commercial and military equipment manufacturers turn more and more to automatic and semi-automatic equipment, electronics assumes an increasingly prominent position.

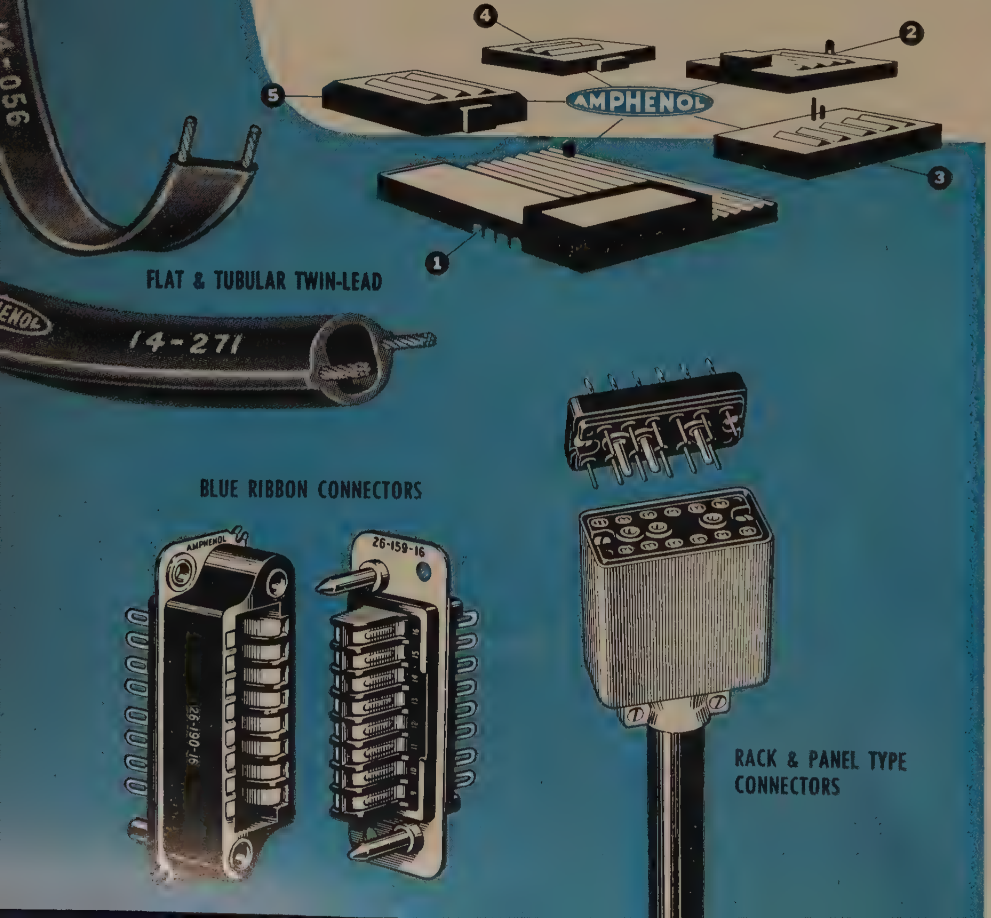
As electronics becomes increasingly a part of our modern living and its future is unlimited in application, Amphenol builds to the future! A program of planned expansion is being conducted in order that the quality and immediate availability of Amphenol electronic components may keep pace with the growing electronics giant.

Underlying the design and construction of quality electronic equipment has been the realization that no equipment functions any better than its RF and electronic circuits. Because of this fact, the electronics industry has come to rely on the standard of Amphenol quality.

Amphenol now has five modern plants, each one equipped and staffed to fulfill a critical phase of the intricate and complex task of supplying quality components to the entire electronics industry.

AMERICAN PHENOLIC CORPORATION

chicago 50, illinois



MEMBERSHIP

The following transfers and admission were approved to be effective as of Febru ary 1, 1953:

Transfer to Senior Member

Almquist, M. L., 463 West St., New York 14, N.
Anspacher, W. B., 1818 Sanford Rd., Silver Sprin Md.
Benfield, A. E., Cruft Laboratory, Harvard Un versity, Cambridge, Mass.
Brinton, R. L., Pacific Gas & Electric Co., 24 Market St., San Francisco, Calif.
Coleman, A. F., 235-B Garfield Ave., Collingswoo 7, N. J.
Cooper, E. H., 1926 Speice Ave., Dayton 3, Ohio
Diehl, E. J., 1107 N. Pitt St., Alexandria, Va.
Geiges, K. S., 75 Fairview Ave., Chatham, N. J.
Groder, M. L., 105-20—66 Ave., Forest Hill L. I., N. Y.
Jakes, W. C., Jr., Bell Telephone Laboratorie Inc., Box 107, Red Bank, N. J.
Jones, O. J., Jr., 7203 Dunglen Ct., Baltimore 2 Md.
Keizer, E. O., Princeton-Kingston Rd., Princeto N. J.
Kretzmer, E. R., Bell Telephone Laboratorie Inc., Murray Hill, N. J.
Kroenert, J. T., c/o USNUSL Ft. Trumbull, Ne London, Conn.
Landis, P. E., 10012 Menlo Ave., Silver Sprin Md.
Lowers, C. E., Supervisor Publications, Curtis Wright Corp., Electronics Divisio Carlstadt, N. J.
Marsh, J. A., 1212 La Forge St., Whittier, Calif.
McCormick, E. M., National Bureau of Standard Corona, Calif.
McCouch, G. P., Aircraft Radio Corp., Boonto N. J.
Miller, E. G., Jr., 3150—44 Pl., Sandia Bas Branch, Albuquerque, N. Mex.
Schnoll, N., 804 Anderson Ave., Palisade, N. J.
Shipman, W. A. 120 E. 41 St., New York 17, N.
Stateman, M. J., 25 Barrister Rd., Levittow L. I., N. Y.
Stolzenbach, R. W., 301 N. Longview St., Dayton Ohio
Tull, W. J., Manville La., Pleasantville, N. Y.

Admission to Senior Member

Byers, E. G., Box 6573, Houston 5, Tex.
Cohen, M. J., RCA Laboratories, Princeton, N.
Dolansky, L. O., Sunnyside St., Jamaica Plain 3 Mass.
Elsner, R. W., 4808 N. 29 Pl., Phoenix, Ariz.
Hall, R. N., Research Laboratory, The Knol Schenectady, N. Y.
Hasenberg, W., 2936 Washington St., Camden N. J.
Haynes, F. B., 23 Elinor Ave., Baltimore 6, Md.
Hersh, H. J., 67 Mechanic St., Freehold, N. J.
Lewis, R. J., 160 Cornell Rd., Audubon, N. J.
Molnar, J. P., Bell Telephone Laboratories, In Mountain Ave., Murray Hill, N. J.
Parks, F. B., 208 Forest St., Winchester, Mass.
Parry, R. Y., 3, Cowbridge Crescent, Malmesbu Wilts., England
Sandor, A., 67-34 Selfridge St., Forest Hills, L. N. Y.
Walters, S. H., 16 Prospect, Winchester, Mass.
Yorinks, A., 17 Stanwood Rd., New Hyde Pa L. I., N. Y.

Transfer to Member

Antosy, S. J., AFN Bayreuth, APO 696-6, c/o Po master, New York, N. Y.
Buchsbaum, W. H., 86-02—249 St., Beller Manor, L. I., N. Y.

(Continued on page 31A)

MEMBERSHIP

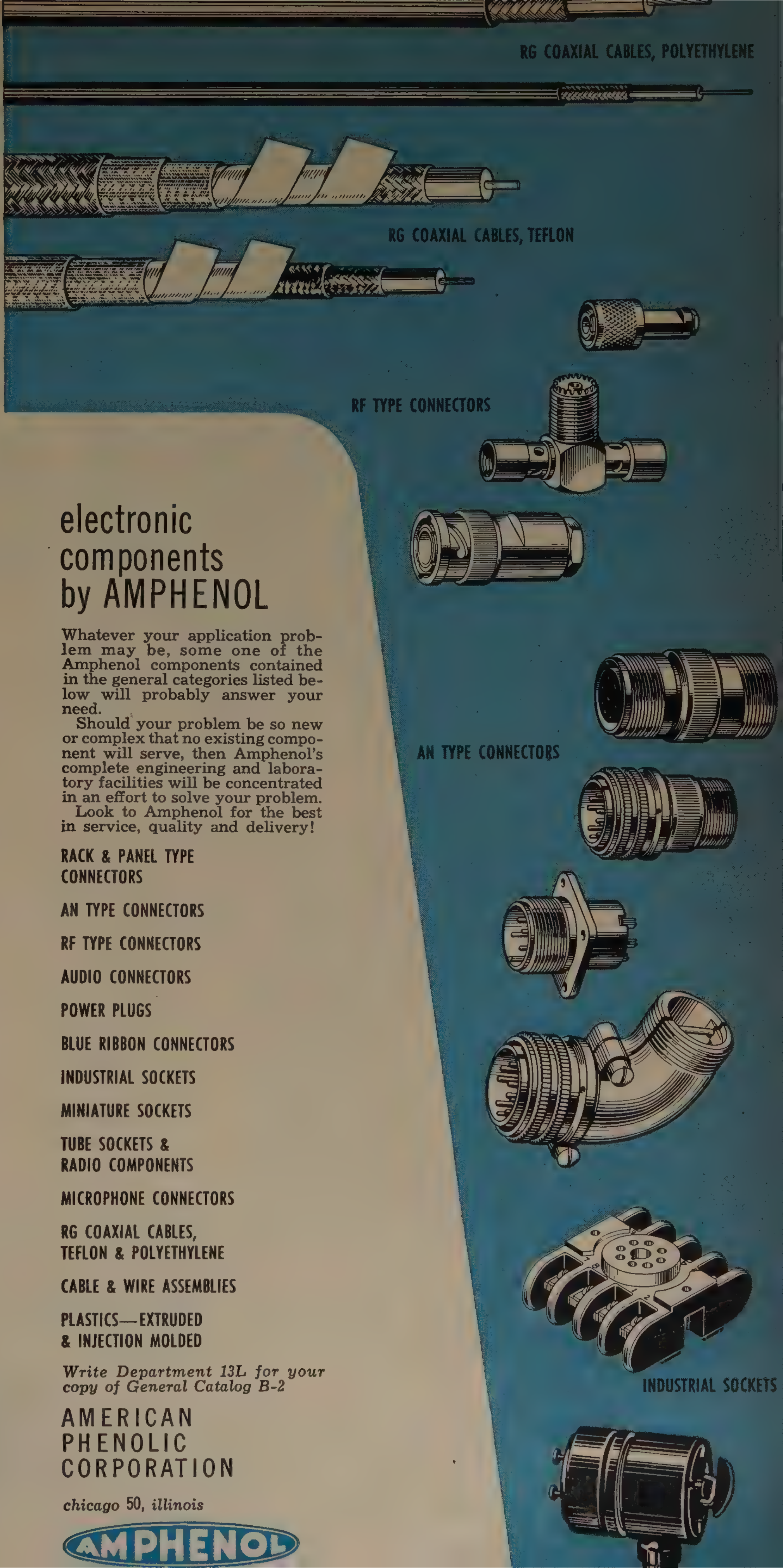
(Continued from page 30A)

Conner, L. M., Box 193, R.F.D. 2, Brandywine, Md.
Hardwick, C. L., 2905 Chestnut St., Fort Wayne 4, Ind.
Harrison, A. E., 5318 N. Zadell Ave., Temple City, Calif.
Hess, R. C., 245 N. Arlington Ave., East Orange, N. J.
Jackson, J. H., 4029 Northwest 15, Oklahoma City, Okla.
Jones, M. S., 208 Grove Ave., Falls Church, Va.
Lehman, H. W., 2757 Bever Ave., S.E., Cedar Rapids, Iowa
Lommasson, T. E., 3018 Monroe St., N.E., Albuquerque, N. Mex.
Millard, A. M., Southern New England Telephone Co., 227 Church St., New Haven, Conn.
Nisenoff, N., 39 South St., Red Bank, N. J.
Paul, A. W., Division 17, National Bureau of Standards, Rm. 230, Connecticut Ave. Annex, Washington 25, D. C.
Rubin, S., 6817 Georgia Ave., N.W., Washington 12, D. C.
Schrader, G. F., 716 Alhambra Rd., Richmond 11, Calif.
Schultz, R. S., 6024 Eighth St., N.W., Washington 11, D. C.
Sege, T. D., 312 Main St., Roslyn, L. I., N. Y.
Srivastava, G. P., Assistant Wireless Officer, Police Wireless, Dilkusha Rd., Lucknow, U.P., India
Susskind, C., Microwave Laboratory, Stanford University, Stanford, Calif.
Rynder, L. S., 140 Rockingham St., Toledo 10, Ohio
Weber, W. H., Box 223, Los Alamos, N. Mex.
Worthington, J. W., Jr., 318 Hamilton, Rome, N. Y.
Wynn, J. B., Jr., 1328 Orange Blossom Dr., Eau Gaillie, Fla.
Zwarra, H. J., 722 N. Broadway, Milwaukee 2, Wis.

Admission to Member

Arant, E. W., Redstone Arsenal, Huntsville, Ala.
Bailey, J. E., 56 Oxford Ave., Dayton 7, Ohio
Barton, C. H., 775th A C & W Sq., Cambria, Calif.
Bishop, R. I., c/o Electronics Department, Bldg. 3209, Great Lakes, Ill.
Boop, W. E., Apt. 3-G, 17 Schenck Ave., Great Neck, L. I., N. Y.
Canup, R. E., 5934 Doolittle, Houston, Tex.
Carlson, H. A., Turin Rd., R.F.D. 3, Rome, N. Y.
Clarkson, G. A., 3035 Barclay Ave., Montreal, Que., Canada
Collier, R. E., 2209 Crescent Ave., Fort Wayne 3, Ind.
DeWolf, N., Electronic Research & Development Co., 407 Main St., Melrose, Mass.
Dorsett, E. A., General Delivery, 38 Bonnie Circle, Melbourne, Fla.
Fabricius, J. H., R.F.D. 1, North Adams, Mass.
Feibel, R. L., RCA Service Co., Inc., Government Service Division, Bldg. W2-3, Gloucester, N. J.
Fisher, R. W., 48 Greenwood Dr., S., San Francisco, Calif.
Fletcher, T. C., 2024 S. Eighth, Arcadia, Calif.
Georgia, A., R.F.D. 4, Xenia, Ohio
Greene, E. E., 9407 Garwood St., Silver Spring, Md.
Grenier, G. H., Box 177, Closter, N. J.
Hangartner, J. E., 1512 Sioux Dr., El Paso, Tex.
Hanisch, W. R., 12608 Valley View Dr., Los Altos, Calif.
Hanlon, R. M., Fairchild Guided Missiles Division, Wyandanch, N. Y.
Harvey, C. C., Box 623, Langley AFB, Va.
Holmes, W. T., Tetrad Co., Inc., 4054 Ocean Park Ave., Venice, Calif.
Howes, R. B., Jr., 6375 Greenway Rd., Fort Worth, Tex.

(Continued on page 92A)



electronic
components
by AMPHENOL

Whatever your application problem may be, some one of the Amphenol components contained in the general categories listed below will probably answer your need.

Should your problem be so new or complex that no existing component will serve, then Amphenol's complete engineering and laboratory facilities will be concentrated in an effort to solve your problem.

Look to Amphenol for the best in service, quality and delivery!

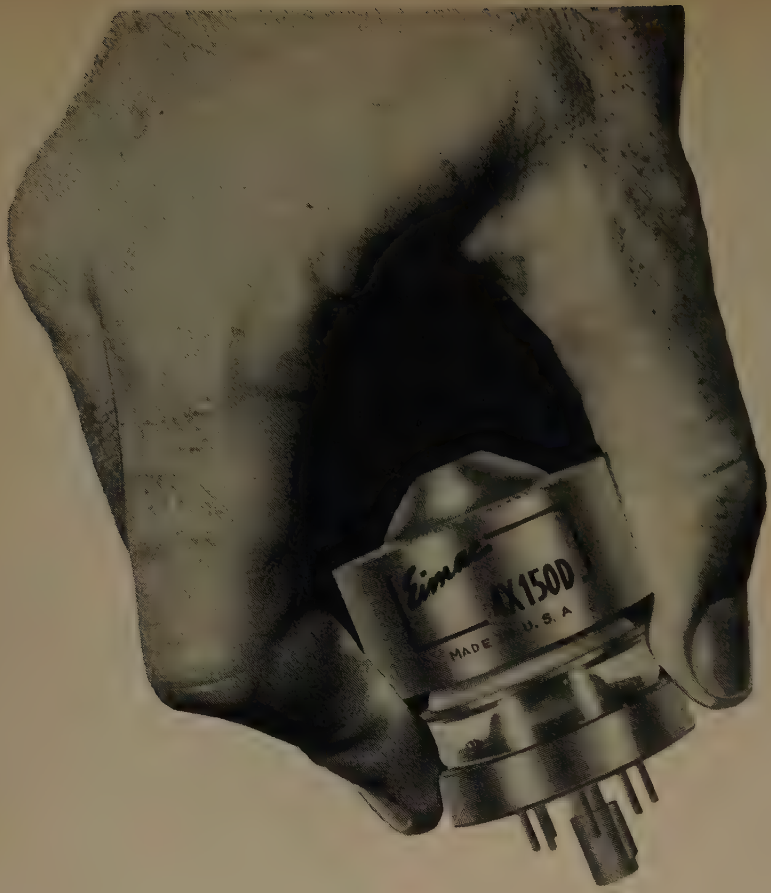
RACK & PANEL TYPE CONNECTORS
AN TYPE CONNECTORS
RF TYPE CONNECTORS
AUDIO CONNECTORS
POWER PLUGS
BLUE RIBBON CONNECTORS
INDUSTRIAL SOCKETS
MINIATURE SOCKETS
TUBE SOCKETS & RADIO COMPONENTS
MICROPHONE CONNECTORS
RG COAXIAL CABLES, TEFLON & POLYETHYLENE
CABLE & WIRE ASSEMBLIES
PLASTICS—EXTRUDED & INJECTION MOLDED

Write Department 13L for your copy of General Catalog B-2

AMERICAN
PHENOLIC
CORPORATION

chicago 50, illinois

AMPHENOL



NEW...
CUSTOM DESIGNED FOR AIRCRAFT

Typical Operation

Radio Frequency Power Amplifier or Oscillator

Class-C telegraphy or FM telephony, 200-400 mc.

D-C Plate Voltage	1000 volts
D-C Screen Voltage	250 volts
D-C Grid Voltage	—110 volts
D-C Plate Current	160 ma
D-C Screen Current	6 ma
D-C Grid Current	8 ma
Driver Output Power	8 watts
Power Input	160 watts
Useful Power Output	100 watts

Eimac announces the development of the 4X150D radial-beam power tetrode designed for equipment simplification in commercial and military aircraft and vehicular operation. Through a specially constructed heater that has a rating of 26.5 volts at 0.57 amperes, Eimac presents aviation with a tube ideal for 24-28 volt electrical systems. Except for the heater the 4X150D is identical to the universally accepted 4X150A and can be used with the 4X150A air-system socket. The 4X150D is a natural for aircraft and mobile equipment because it combines high power output with small size and a ruggedness that gives it great immunity to damage by thermal or physical shock. Employed as an amplifier, oscillator or frequency multiplier into UHF regions, the 4X150D has a rated plate dissipation of 150 watts.

For further information or for consultation about your power tube needs write our application engineering department.

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

Eimac TUBES

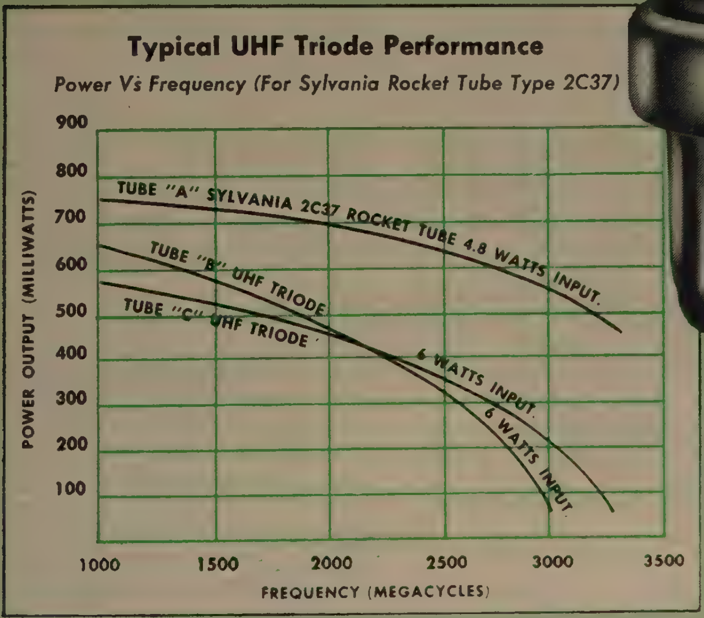
Here's how to get

GOOD USABLE POWER AT UHF

Sylvania Rocket Tube Type 2C37 supplies 450 Mw at 3300 Mc.

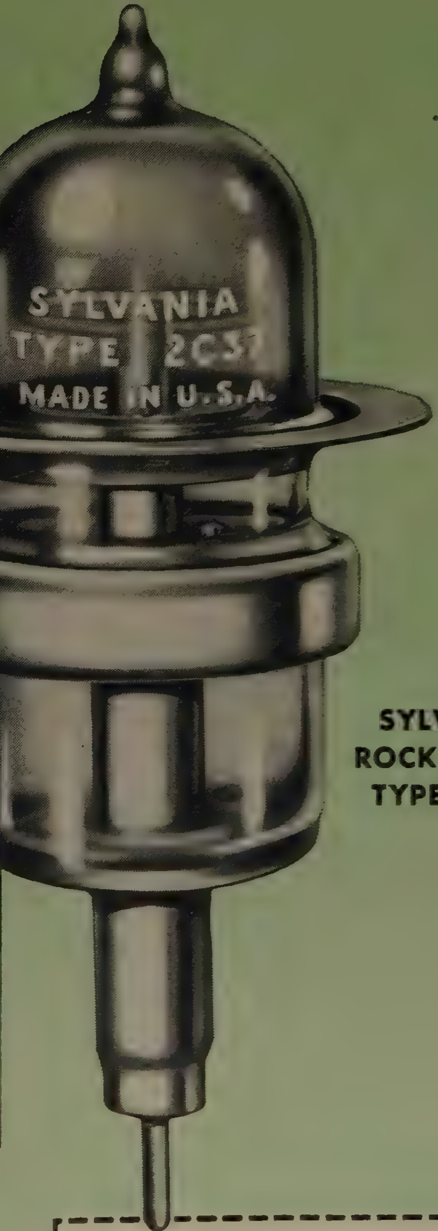
Because of their high power throughout the UHF spectrum, Sylvania rocket tubes are especially recommended for service as pulsed oscillators, cw oscillators, rf amplifiers and frequency multipliers . . . this is one more reason why it will pay you to specify SYLVANIA.

Compare Sylvania Rocket Tube's Performance



Typical UHF Triode Performance

Power Vs Frequency (For Sylvania Rocket Tube Type 2C37)



SYLVANIA ROCKET TUBE TYPE 2C37

SYLVANIA

ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

Sylvania Electric Products Inc.
Dept. 3E-4502, 1740 Broadway, N. Y. 19, N. Y.

Please send me latest data sheets concerning Sylvania Rocket Tubes

Name______________________________

Street______________________________

City________________Zone______State________

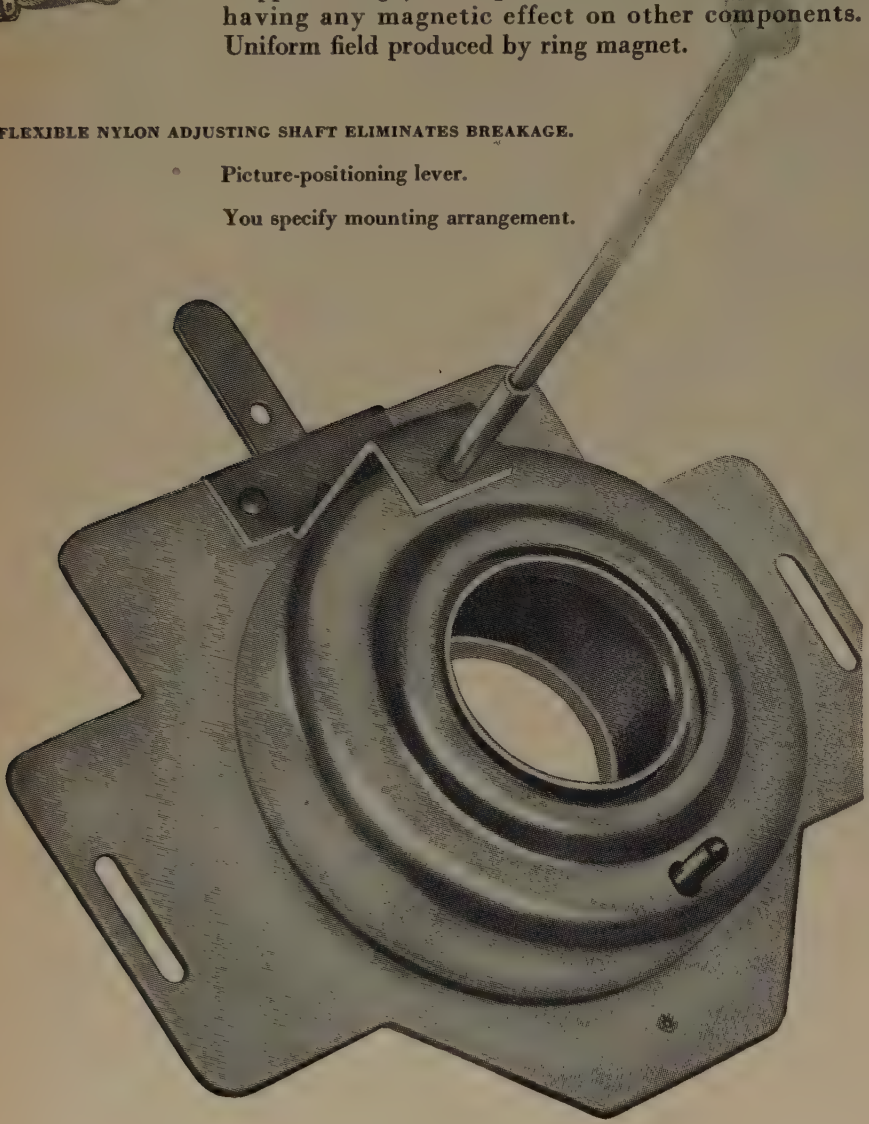
NEWLY REDESIGNED FOR 21″ and 27″ TUBES AT NO PRICE INCREASE. Also perfectly focuses all smaller tubes. Highly efficient ring magnet uses only 4-oz. Alnico P. M.

NO HARMFUL EXTERNAL FIELD. Ring magnet is completely enclosed by the external shunt (an original Heppner design). This prevents the leakage field from having any magnetic effect on other components. Uniform field produced by ring magnet.

FLEXIBLE NYLON ADJUSTING SHAFT ELIMINATES BREAKAGE.

Picture-positioning lever.

You specify mounting arrangement.



Write today for information on lowering your set costs with this Focomag.

HEPPNER
MANUFACTURING COMPANY
Round Lake, Illinois (50 Miles Northwest of Chicago)
Phone: 6-2161
SPECIALISTS IN ELECTRO-MAGNETIC DEVICES

Representatives: **John J. Kopple**
60 E. 42nd St., New York 17, N.Y.
James C. Muggleworth
506 Richey Ave., W., Collingswood, N. J.
Ralph Haffey
2417 Kenwood Ave., Ft. Wayne 3, Indiana
Irv. M. Cochrane Co.
408 So. Alvarado St., Los Angeles, Calif.

Industrial Engineering Notes[1]

INDUSTRY STATISTICS

Sales of both receiving tubes and cathode-ray tubes increased substantially in October, 1952, over the preceding month, according to estimates compiled by RTMA. Receiving tubes sales totaled 41,880,318 units valued at $28,379,281.57 compared with 34,196,286 tubes valued at $24,432,747.60 in September, 1952. October sales of cathode-ray tubes to equipment manufacturers totaled 862,431 units valued at $19,761,300.59 compared with 640,793 picture tubes valued at $14,326,017.64 sold in September. Seventy-one per cent of the cathode-ray tubes sold to set manufacturers in October were 18 inches and larger in size.

INCREASE IN AMATEUR OPERATORS

There now are 117,069 licensed amateur radio stations in the country, FCC Commissioner G. E. Sterling told the New York Radio Club recently. This is an increase of approximately 67 per cent over the number at the end of World War II, he said.

In the two new licensing classifications—novice and technician which were authorized on July 17, 1951—there are 12,730 and 3,601 licensees, respectively, he said, pointing out that "growth of amateur radio since the close of World War II is a healthy one."

RESEARCH NEWS

A number of technical reports of interest to the electronic industry now have been made available to industry, the Office of Technical Services has announced. Included among those reported in the October Bibliography of Technical Reports are the following:

> "Investigation of Fieldistor Principles," (PB 107443), Library of Congress, Photoduplication Section, $2, microfilm, $3.75, photostat.
>
> "Traveling-Wave Tube as a Phase-Shifter," (PB 111036), Office of Technical Services, Department of Commerce, Washington 25, D. C., mimeograph, 25 cents.
>
> "Electron Tube Research and Development,"—Subminiature Versions of RMA Types 616, 6AG7, and One-Half of 6 AS7G and Subminiature Diode Type QF546 (PB 107357), Photoduplication Section, Library of Congress, microfilm, $2, photostat $3.75.
>
> "Search for New Resistive Materials for High-Stability, High-Temperature-Operating Resistors," (PB 107355), Photoduplication Section, Library of Congress, microfilm, $2, photostat, $3.75.

(Continued on page 68A)

---

[1] The data on which these NOTES are based were selected by permission from *Industry Reports*, issues of November 28, December 5, December 15, and December 19, 1952, published by the Radio-Television Manufacturers Association, whose co-operation is gratefully acknowledged.

HERE IT IS!

An Oil-Filled, Open-Type Transformer Only Possible With

FORM FLEX®
Patent Pending

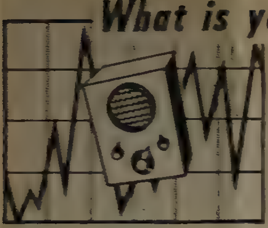
Better corona suppression, longer life — better heat dissipation — less noise. And all this in a transformer that is 40% lighter and 30% less bulky. Manufactured only by Aircraft Transformer Corporation and its licensees.

Complete data available—write to

AIRCRAFT TRANSFORMER CORPORATION

MANUFACTURERS OF INDUCTIVE EQUIPMENT • LONG BRANCH, NEW JERSEY, LONG BRANCH 6-6250

What is your Delay or Regulating Problem?



For the most effective solution use the

SIMPLEST, MOST COMPACT
MOST ECONOMICAL
HERMETICALLY SEALED

AMPERITE

THERMOSTATIC DELAY RELAYS

STANDARD

Provide delays ranging from 2 to 120 seconds.

- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- *Hermetically sealed.* Not affected by altitude, moisture, or other climate changes.
- Circuits: *SPST only*—normally open or normally closed.

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from −55° to +70°C. Heaters consume approximately 2 W. and may be operated continuously. The units are *most compact, rugged, explosion-proof, long-lived,* and—*very inexpensive!*

MINIATURE

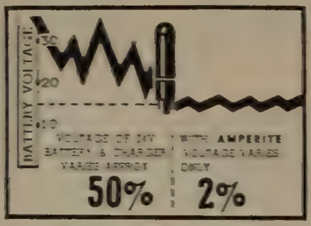
TYPES: Standard Radio Octal, and 9-Pin Miniature.

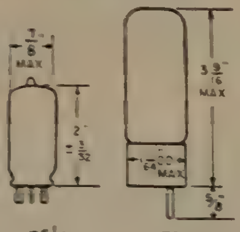
PROBLEM? Send for Bulletin No. TR-81

BALLAST-REGULATORS

T9 BULB

- Amperite Regulators are designed to keep the current in a circuit ***automatically regulated*** at a definite value (for example, 0.5 amp).
- For currents of 60 ma. to 5 amps. Operates on *A.C., D.C., or Pulsating Current.*
- Hermetically sealed, light, compact, and most inexpensive.





Maximum Wattage Dissipation: T6½L—5W. T9—10W.

Amperite Regulators are the simplest, most effective method for obtaining *automatic regulation* of current or voltage. *Hermetically sealed,* they are not affected by changes in altitude, ambient temperature (−55° to +90°C), or humidity. Rugged; no moving parts; changed as easily as a radio tube.

Write for 4-page Technical Bulletin No. AB-51

AMPERITE CO., Inc. 561 Broadway, New York 12, N. Y.
In Canada: Atlas Radio Corp., Ltd., 560 King St., W., Toronto 28

Industrial Engineering Notes

(*Continued from page 66A*)

"Electrical Properties of Pentachlordiphenyl-Impregnated Glass Fiber Paper," (PB 111030), Office of Technical Services, mimeograph, 50 cents.

"Radome Materials Research and Fabrication Development Service," (PB 107372), Photoduplication Section, Library of Congress, microfilm, $3, photostat, $8.75.

"Development of Subminiature High-Temperature Capacitors," (PB 107358), Photoduplication Section, Library of Congress, microfilm, $2, photostat, $3.75.

"Heterodyne Filter," (PB 107409), Photoduplication Section, Library of Congress, microfilm, $3.50, photostat, $10.

"Single-Core Magnetic Amplifier as a Computer Element," (PB 111033), Office of Technical Services, Department of Commerce, Washington 25, D. C., mimeograph, 50 cents.

"Development of Center-of-Gravity Type Socket and Vibration Isolators for Aircraft Electronic Equipment," (PB 107354), Photoduplication Section, Library of Congress, microfilm, $2.25, photostat, $5.

"Development of Connector, Watertight, 10-Contact," (PB 107283), Photoduplication Section, Library of Congress, microfilm, $2.75, photostat, $7.50.

"Development of 'Y' Type Electrical Pulse Coaxial Connector," (PB 107356), Photoduplication Section, Library of Congress, microfilm, $1.75, photostat, $2.50.

"Theory of Impulse Noise Measurements," (PB 107414), Photoduplication Section, Library of Congress, microfilm, $2, photostat, $3.75.

"Units and Standards of Measurement Employed at the National Physical Laboratory," (PB 107315), British Information Service, 30 Rockefeller Plaza, New York 20, N. Y., 25 cents.

"Final Engineering Report, Consulting Electronic Engineering Services on Aviation Medical Acceleration Laboratory, and Electronics Standards Laboratory," (PB 107383), Photoduplication Section, Library of Congress, microfilm, $7, photostat, $25.

"Research and Development of New Electronic Technician Selection Tests," Library of Congress, microfilm, $2, photostat, $3.75.

"Sleeve Antenna," (PB 107272), Library of Congress, Photoduplication Section, microfilm, $5.75, photostat, $18.75.

"Current and Charge Distribution of Antennas and Open-Wire Lines," (PB 107272), Library of Congress, Photoduplication Section, microfilm, $4.50, photostat, $13.75.

(*Continued on page 72A*)

it's news!

They have als
ium percepti a generator
for use with A measuring
test bridge.
This compan h also devel-

last y d has grown in the
past ars t b o of the
larges ms ctronic
field. ha e

needs.
For so time now scientists
bee rying to develop an

e labora-
Associates,
ek a new
ch should
every per-
ne tabula-
mation.
by Elec-
the Data-
Variplotter
was devel-
Associates.
the market
now. Th
rmation
is ea ly
held fi mly
face the
ins e ac-

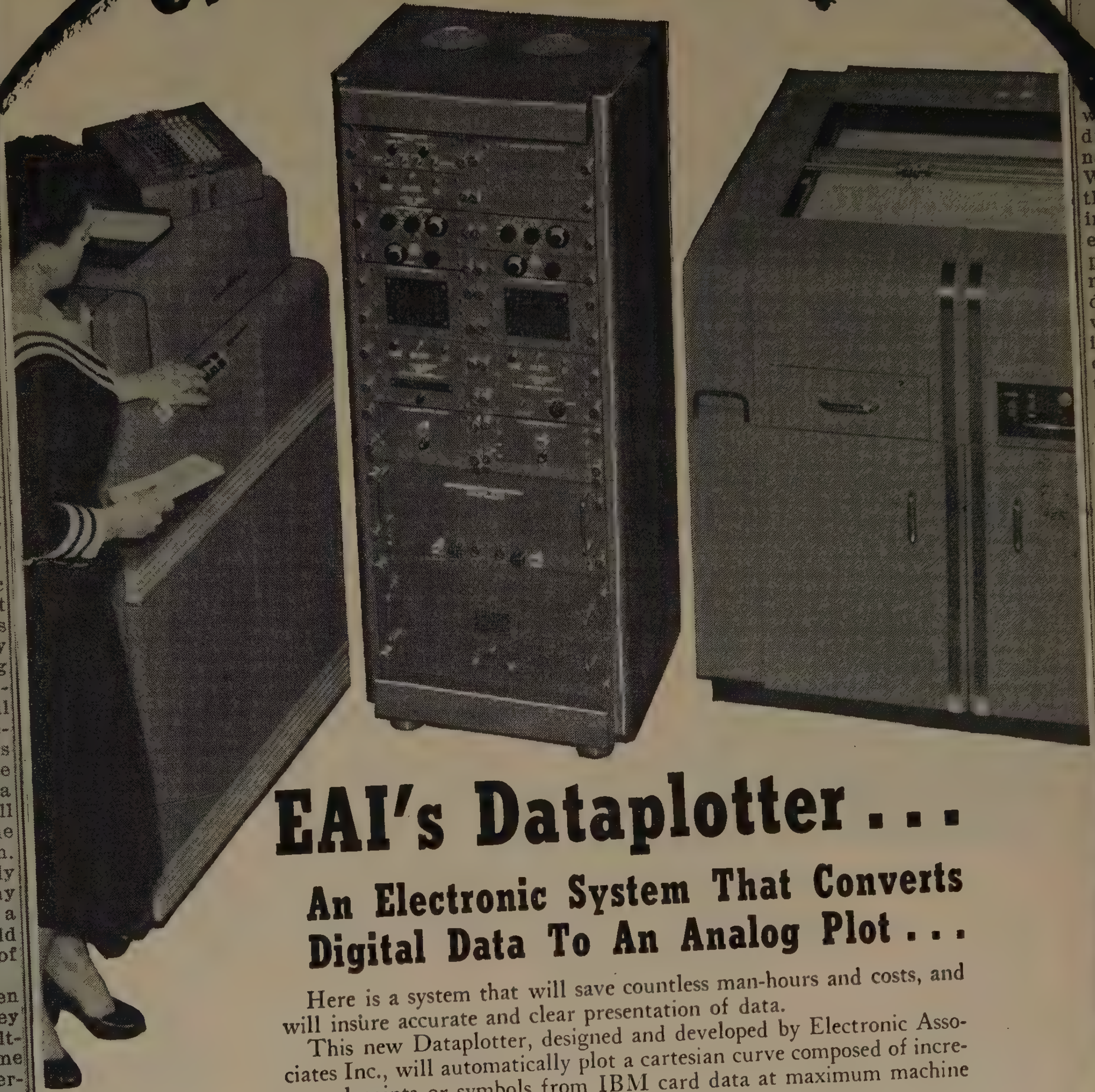
ectr ic As-
Data-
a digi-
r Model
tely new
eloped by
informa-
tted on the
ard. This
verter, like
ent in this
in a metal
ece of equip-
is the data

r Electronic
eported that
er system is
great many
the recording
d. "This sys-
esman, "will
problems re-
ficiency. This
considerable
far as data
ned, and will
wn the time
a information.
l undoubtedly
r many, many
the work in a
e that would
large crew of

nent has been
rms, and they
it has result-
avings of time
person inter-
plete inform-
is urged to
c Associates,

tes, Inc.
in

ment today
ducing a
he ommercial
oni ssociates,
anch ew Jer-
re n develop-
tory irsts.
ememb d that
ates, Inc., was
ompanies to de-
board with the
mercial fi . n
esearch and
he ve d e
ot p t g
on ss ia s
evelo ed ot e



EAI's Dataplotter . . .

An Electronic System That Converts Digital Data To An Analog Plot . . .

Here is a system that will save countless man-hours and costs, and will insure accurate and clear presentation of data.

This new Dataplotter, designed and developed by Electronic Associates Inc., will automatically plot a cartesian curve composed of incremental points or symbols from IBM card data at maximum machine reading speed.

It will accept data from other inputs — Magnetic tape, keyboards, digital computers, etc.

It will retain at all times the basic accuracy of the digital system.

Here's what the Dataplotter system consists of:

Variplotter Model 205G
Digital-to-analog converter, Model 417
Data input keyboard

For further information, clip out and mail the coupon below. No obligation.

ELECTRONIC ASSOCIATES *Incorporated*

Electronic Associates Inc.
Long Branch
New Jersey

Gentlemen: Would you be kind enough to send me detailed information on your Dataplotter.

Name ....
Company .... Title ....
Address ....
City .... Zone ..... State ....

write

cently by E
Inc., will do
and with no e
the operato
firms and inc
to put this ne
plants, for i
down time an

Men Fro

Electronic
inated wi
ers and
w the Ne
du y Deta
na rps, a
Wa . Th
the itary
ing led t
ever obal
prod on
mest cen
dustr rg
with so
ices o du
ernme ag
to 50 l
Th
ciates,
dated
tific pr
produce
These
ideal
building
feet of
land in
compan
original
well a
researc

H

The
laborat
machin
and te
and to
iliary
geared
depart
ciates
fied
Natio
and
Th
Elec
triu
scie
de p
an tc
a n
o bu
ms
ssful
ar.
This
premis
tronic
This
more
perfor
100%
Inc.
scient
new
and
mend
plott
of as
fract
dust
that
from
too

Designed for Application

SHAFT LOCKS

In addition to the original No. 10060 and No. 10061 "DESIGNED FOR APPLICATION" shaft locks, we can also furnish such variations as the No. 10062 and No. 10063 for easy thumb operation as illustrated above. All types are available in bright nickel finish to meet Signal Corps requirements or black oxide to meet Navy specifications.

JAMES MILLEN MFG. CO., INC.

MAIN OFFICE AND FACTORY
MALDEN
MASSACHUSETTS

Industrial Engineering Notes

(Continued from page 68A)

"Study of Radiation Patterns of Several Proposed High-Frequency Communication Antennas for the 'North Star' Aircraft," (PB 107194), National Research Council of Canada, Ottawa. "Modes in Waveguides that Contain Ferrites," (PB 111038), Office of Technical Services, 50 cents.

"Measurements on Posts and Irises in Circular Waveguides," (PB 107193), National Research Council of Canada, Ottawa, 25 cents.

The November, 1952 Bibliography of Technical Reports includes the following:

"Study of Automatic Printed Circuit Techniques, Final Report," (PB 107405), available from the Photoduplication Section, Library of Congress, microfilm, $6.50, photostat, $22.50.

"Printed Circuit Techniques; An Adhesive Tape-Resistor System," (PB 107510), Superintendent of Documents, Government Printing Office, Washington 25, D. C., 30 cents.

"Design and Development of Miniature Hermetically Sealed Power Transformers, Final Report," (PB 101166s3), Photoduplication Section, Library of Congress, microfilm, $6.25, photostat, $21.25.

"Power Supplies, Engineering Reports and Data," (PB 107413), Photoduplication Section, Library of Congress, microfilm, $2.25, photostat, $5.

"Blower, Subminiature, for Spot Cooling of Electronic Components," (PB 107605), Photoduplication Section, Library of Congress, microfilm, $1.75, photostat, $2.50.

"Lightweight Waveguides, Final Reports," (PB 107412), Photoduplication Section, Library of Congress, microfilm, $2.50, photostat, $6.25.

"Bonding Materials, Metallic Mating Surfaces: Low Radio Frequency Impedance, Summary Report," (PB 107359), Photoduplication Section, Library of Congress, microfilm, $2, photostat, $3.75.

"Seals: Determination of Leakage Values," (PB 107606), Photoduplication Section, Library of Congress, microfilm, $1.75, photostat, $2.50,

"Development of Sealed Switch, Rotary Band-Change Type, Final Progress Report," (PB 107498), Photoduplication Section, Library of Congress, microfilm, $2.75, photostat, $7.50.

"Hermetically Sealed Mechanical Drive," (PB 107531), Photoduplication Section, Library of Congress, microfilm, $1.25, photostat, $1.25.

TV Station Grants

Moving with greater speed than had been expected by many, the Federal Com-

(Continued on page 74A)

CLIMATE-PROOF PACKAGING
CARGO

Here's a quick solution to

MILITARY PACKAGING

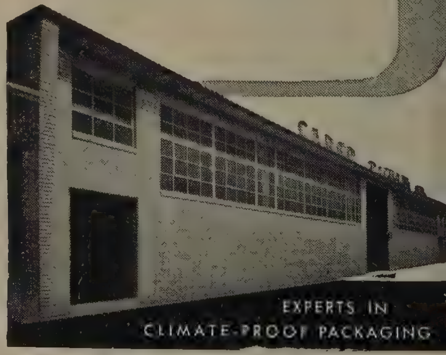
CARGO PACKERS CLIMATE-PROOF PACKAGING

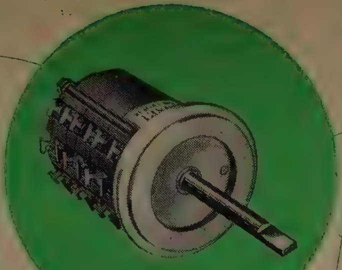
Meets all Specifications for Signal Corps, Navy and Air Force Shipments of Electronic Equipment with Facilities that include—

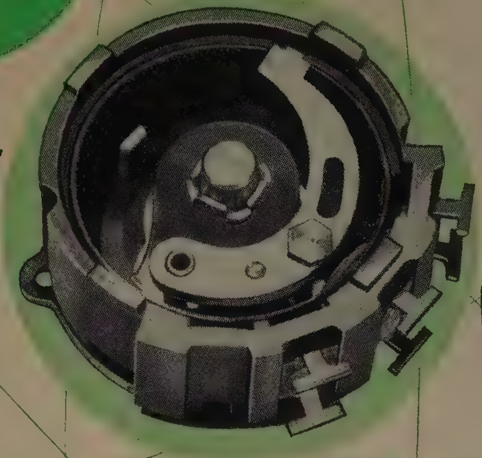
- SPECIAL PACKAGING EQUIPMENT
- EXPERTS IN MILITARY SPECIFICATIONS
- ECONOMICAL ASSEMBLY LINE METHODS
- FULL COMPLIANCE IN EVERY DETAIL
- COMPETENT CONSULTING SERVICE

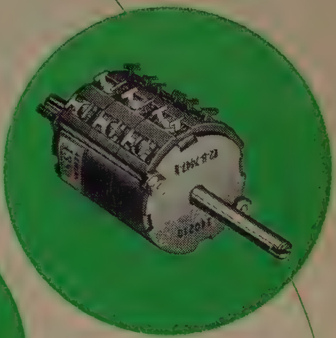
NEW ILLUSTRATED BROCHURE explains in detail how Cargo Packers can economically handle all details of your military packaging problems. You save valuable plant space, costly equipment and the need for experienced specification packaging experts. Find out now, how Cargo Packers production line methods save you time, money, endless detail work, and costly errors. Request your copy, now!

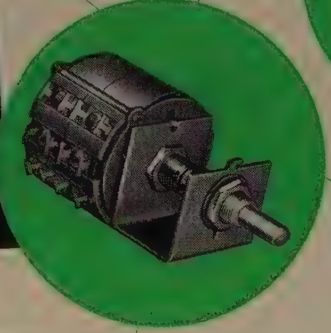
CARGO PACKERS
INCORPORATED
73 RUTLEDGE STREET
BROOKLYN 11, NEW YORK











YOU NAME IT WE'LL MAKE IT

economically at

CRITICAL CONTROLS

HEADQUARTERS

Ingenuity saves you money when Clarostat engineers collaborate. Mainly because certain basic designs, parts and production procedures are applied to both *standard* and *special* control requirements.

Take the Series 42a high-precision wire-wound controls, for example. The basic unit is a marvel of *quality* production. Exceeds JAN-R-19 specs where applicable. Used alone or in multi-tandem assemblies, it meets tolerances even to 0.5%.

But Clarostat doesn't stop with the standard unit. Series 42a is made in many variations—all kinds of shafts; high-torque; continuous rotation; many different mountings; etc.

Typical of Clarostat engineering ingenuity—channeled to your exceptional control needs—and at real savings!

STAND PAT WITH

Don't hesitate to submit that "difficult" control problem to Clarostat engineers. They thrive on making the "impossible", possible. Engineering data on request.

CLAROSTAT Controls & Resistors

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario

LORD MOUNTINGS

and

FLEXIBLE COUPLINGS

Improve Performance

of

HOME APPLIANCES

For a quarter century Lord has solved the vibration and shock problems of industry. In the manufacture of home appliances the necessity for controlling vibration is of first importance.

For example in the Dormeyer Blender used in thousands of homes every day, a Lord Flexible Coupling provides smooth power delivery for the blending action and accommodates shaft misalignment between motor and blades. In addition, four Lord Mountings prevent vibration from telegraphing to the blending jar. These precision Lord Mountings also assure accurate positioning of the jar on the base.

Whatever your design problem may be . . . vibration, shock, or smooth power transmission . . . we welcome the opportunity to help you.

BURBANK, CALIFORNIA
233 South Third Street

DALLAS, TEXAS
413 Fidelity Union Life Building

PHILADELPHIA 7, PENNSYLVANIA
725 Widener Building

DAYTON 2, OHIO
410 West First Street

DETROIT 2, MICHIGAN
7310 Woodward Ave.

NEW YORK 16, NEW YORK
280 Madison Avenue

CHICAGO 11, ILLINOIS
520 N. Michigan Ave.

ERIE, PENNSYLVANIA
1635 West 12th Street

LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER

Headquarters for
VIBRATION CONTROL

Industrial Engineering Notes

(Continued from page 72A)

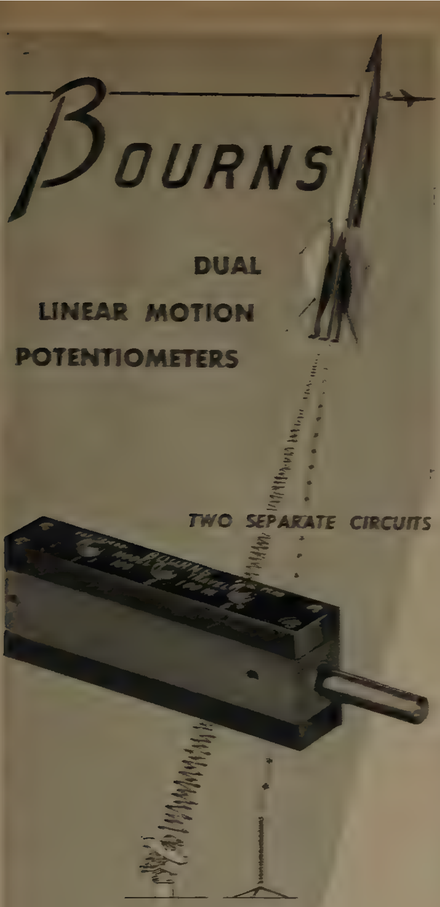
munications Commission, despite its limited staff, has authorized construction permits up to December, 1952, for 157 new television stations since it lifted the more than three-and-one-half year old "freeze" eight months ago. The new station grants passed the 150 mark the third week in December, 1952.

To date (December, 1952) the FCC has granted 147 commercial CP's with 106 of them in the uhf band and 41 in the vhf band. Ten noncommercial educational outlets, eight of them in the uhf band and two in the vhf sector, also have been authorized.

During the last week in November, 1952, and the first three weeks in December, 1952, construction permits were issued to the following stations:

Baton Rouge, La., Capital Television & Broadcasting Co., Channel 40.
Baltimore, Md., WITH-TV Inc., Channel 60
Beaumont, Tex., Channel 31
Birmingham, Ala., The Birmingham News Co., Channel 42
Birmingham, Ala., Johnston Broadcasting Co., Channel 48
Buffalo, N. Y., Chautauqua Broadcasting Corp., Channel 17
Colorado Springs, Colo., TV Colorado Inc., Channel 11
Danville, Ill., Northwestern Publishing Co., Channel 24
Danville, Va., Piedmont Broadcasting Corp., Channel 24
Dayton, Ohio, Skyland Broadcasting Corp., Channel 22
Easton, Pa., Easton Publishing Co., Channel 57
Hazelton, Pa., Hazelton Broadcasting Co., Inc., Channel 3
Kalamazoo, Mich, Howard D. Steere, Channel 36
Lake Charles, La., Southland Telecasters, Channel 25
Lima, Ohio, Channel 35
Los Angeles, Calif., John Poole Broadcasting Co., Channel 22
Louisville, Ky., Mid-America Broadcasting Corp., Channel 21
Mobile, Ala., Pape Broadcasting Co., Inc., Channel 10
Monto, La., Delta Television Inc., Channel 43
Monroe, La., Channel 8
New Brunswick, N. J., Department of Education, State of New Jersey, Channel 19
Oshkosh, Wis., Oshkosh Broadcasting Co., Channel 48
Peoria, Ill., Hilltop Broadcasting Co., Channel 19
Philadelphia, Pa., Pennsylvania Broadcasting Co., Channel 29
Poughkeepsie, N. Y., Mid-Hudson Broadcasters Inc., Channel 21
San Angelo, Tex , KGKL, Inc., Channel 3
San Angelo, Tex., Westex Television Co., Channel 8
Tacoma, Wash., KMO Inc., Channel 13

(Continued on page 75A)



BOURNS

DUAL LINEAR MOTION POTENTIOMETERS

FOR AIRCRAFT AND GENERAL INDUSTRY

Designed for precise instrumentation in automatic control circuits for aircraft, guided missiles and general industry, BOURNS linear motion potentiometers accurately translate mechanical position or movement into two independent signals . . . one signal often used for feed-back control and the other for telemetering.

This dual instrument possesses all the advantages of two single potentiometers and in addition, saves space, weight and installation time. With this wire-wound potentiometer a resolution of .001 inch is obtainable in standard ranges from 1 to 6 inches.

BOURNS designs and manufactures other potentiometer instruments which measure gage pressure, differential pressure, altitude and acceleration.

BOURNS LABORATORIES

6135 Magnolia Avenue, Riverside, California
Technical Bulletin on request, Dept. 79

Industrial Engineering Notes

(Continued from page 74A)

Tacoma, Wash., Tribune Publishing Co., Channel 11
Tucson, Ariz., Catalina Broadcasting Co., Channel 9
West Palm Beach, Fla., WIRK-TV, Inc., Channel 21
Wichita Falls, Tex., Wichtex Radio and Television Co., Channel 3
Yakima, Wash., Channel 29 and 23
Zanesville, Ohio, Southeastern Ohio Television System, Channel 50

TV OPERATING AUTHORITIES

To date, December, 1952, the FCC has issued authority to begin telecasting operations to 15 stations in 13 cities. Those stations which were granted this permission, the last week in November and the first three weeks in December, 1952, are: Atlantic City, N. J., WFPG-TV; Austin, Tex., KTBC-TV; Colorado Springs., Colo., TV-Colorado Inc.; Honolulu, T. H., KONA-TV; Mobile, Ala., WALA-TV; South Bend, Inc., WSBT-TV; and Tucson, Ariz., KOPO-TV.

TELEVISION ON AIR IN 21 FOREIGN COUNTRIES

Television is a practical reality today on four continents with 2.4 million sets in use abroad and with TV stations on the air in 21 foreign countries. Two more countries were scheduled to begin service before the end of 1952, according to a report compiled by the State Department.

Following is a report on the status of television in foreign countries compiled by the Television Development Section International Broadcasting Service, U. S. Department of State, and made available to RTMA.

NOTE: In areas where TV service is new, the number of viewers per set is high because of the "ganging up" habit. The average in such areas may be 10 or 15 viewers per set. In some Latin American areas there are reported to be large numbers of large screen receivers, usually projection-type, which are set up in public places, parks, vacant lots, etc., which reach large numbers of people who do not own sets. A report from Sao Paulo, Brazil, estimated that in the autumn and winter of 1951, this would increase the TV audience in that city by around 100,000 persons. In France it is reported community viewing groups are well established in 43 small villages, and the project is being enlarged with the backing of the Ligue Francaise de L'Enseignement (French League for Education).

NOTE: Standards refer to lines, frames, and channel width in mc. respectively.

Country	*Standards*	*Sets*	*Stations*
Argentina	625/25/6	2,500	one, more planned
Australia	Have been planning TV for six years but have not yet started.		
Austria	No TV permitted under occupation rules, but TV film production underway by U. S. groups, and British companies have shown TV equipment there.		

(Continued on page 76A)

When you need a PORTABLE OSCILLATOR

SIE

MODEL MB-1 IS YOUR ANSWER

low distortion battery operated

There are no components of power-line frequency in its output and no transients due to fluctuations in the supply voltages. The small, compact design of this completely portable sine wave generator adapts it to a wide field of usefulness. Frequency range is from 2 to 20,000 CPS with low distortion. A circuit with battery saving features is incorporated in the instrument, so that when maximum signal amplitude is not necessary, less current is drawn from the battery.

SPECIFICATIONS

FREQUENCY RANGES 2 to 20,000 CPS
DISTORTION Less than 1% at any frequency in the audio range
CALIBRATION Within 2% of indicated frequency
FREQUENCY STABILITY 1% on all ranges
AMPLITUDE STABILITY 5%
OUTPUT 2.5 V into a 2,000 ohm load
OUTPUT IMPEDANCE Approximately 400 ohms at 1,000 CPS
BATTERY LIFE In excess of 100 hours when used in intermittent service
WEIGHT With batteries — 20 lbs.
DIMENSIONS With lid in place — 12" x 12" x 11"
FINISH Black Anodized Aluminum Panel with Gray Wrinkle Baked Enamel Case

SOUTHWESTERN INDUSTRIAL ELECTRONICS COMPANY

TIE-TALKS FEATURE

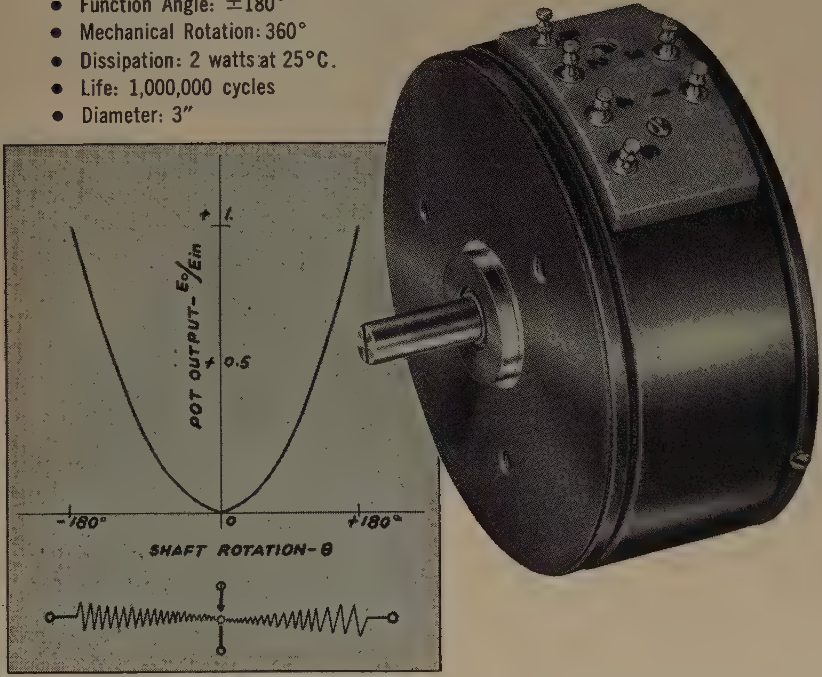
ANALOG COMPUTATION *with* TIC PRECISION POTENTIOMETERS

The type **RVP3-S121** solves the following mathematical equation:

$$\frac{E_o}{E_{in}} = \left(\frac{\theta}{180}\right)^2; \quad -180° \leqq \theta \leqq +180°$$

SPECIFICATIONS

- Total resistance: 2500±5%
- Conformity to function: ±0.25% Ein
- Function Angle: ±180°
- Mechanical Rotation: 360°
- Dissipation: 2 watts at 25°C.
- Life: 1,000,000 cycles
- Diameter: 3"



Your analog computations in control processes, computers, servomechanisms, and telemetering may likewise be solved by Technology Instrument Corporation precision potentiometers, with ease, economy and extreme accuracy. Precision non-linear potentiometers may be designed to meet your requirements from either implicit functions or empirical data. Submit your problem today for our analysis and recommendations.

A complete line of standard sizes is available, ranging from 7" to ½" in diameter. Greatly expanded facilities plus mass production techniques will meet your volume needs yet maintain precision tolerances in both linear and non-linear potentiometers. Write for catalog for complete information.

Engineering Representatives

Cleveland, Ohio — PRospect 1-6171
Chicago, Ill. — UPtown 8-1141
Rochester, N. Y. — Monroe 3143
Canaan, Conn. — Canaan 649
Dayton, Ohio — Michigan 8721
Baltimore, Md. — Plaza 7694
Arnprior, Ont., Can. — Arnprior 400
New York, N. Y. — MUrray Hill 8-5858
Cambridge, Mass. — ELiot 4-1751
Hollywood, Cal. — HOllywood 9-6305
Dallas, Texas — DIxon 9918
Binghamton, N.Y.—Binghamton 3-1511

TECHNOLOGY INSTRUMENT CORP.

535 Main Street, Acton, Massachusetts, Telephone: Acton 3-7711

Industrial Engineering Notes

(Continued from page 75A)

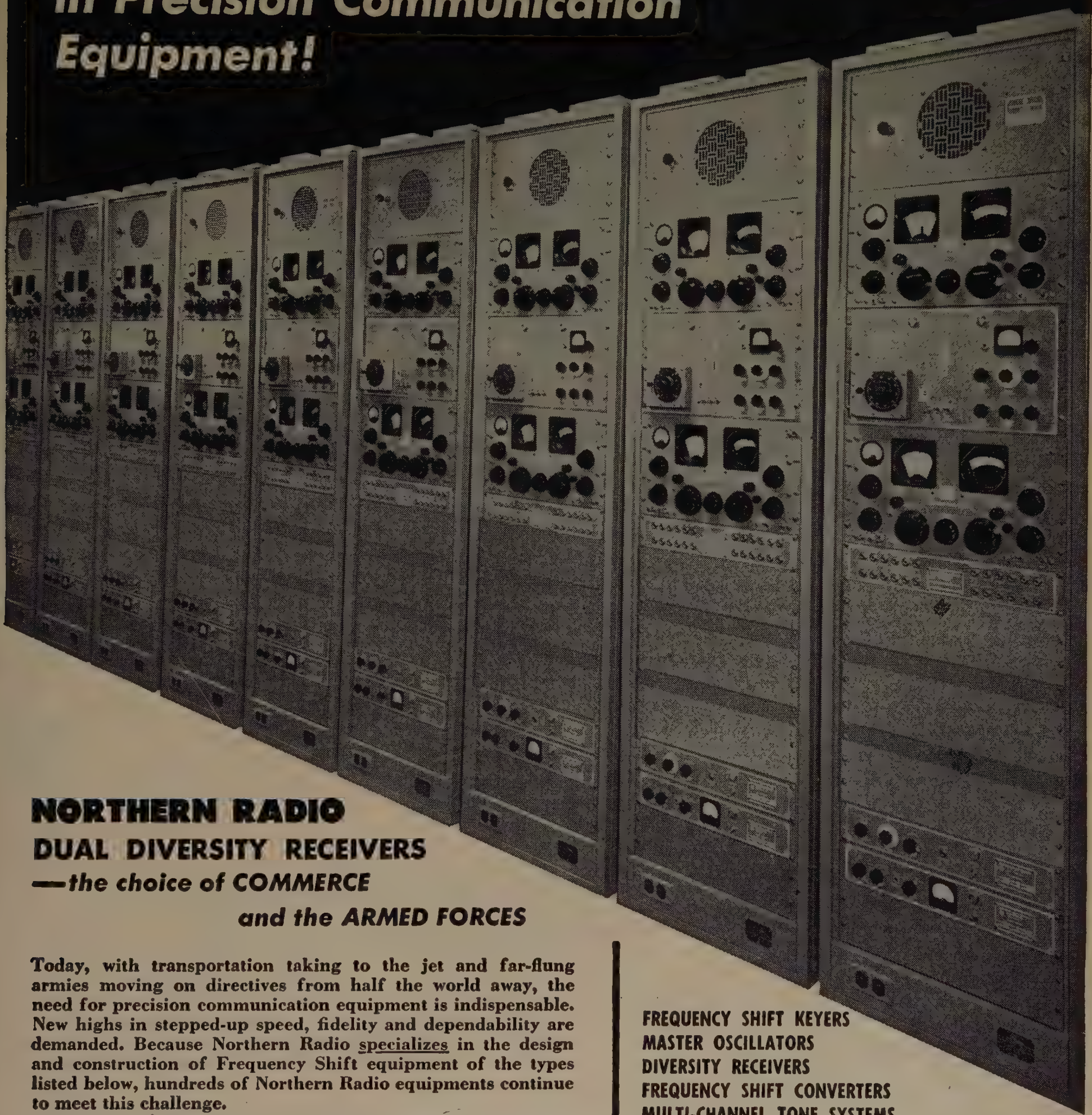
Country	*Standards*	*Sets*	*Stations*
Belgium	625/25/7 819/25/14	3,000	5 planned
Bolivia	Not set, probably 525/30	none	none, planned
Brazil	525/30	45,000	3 on air 3 building 9 more planned
Canada	525/30/6	150,000	2, more planned
Chile	525/30/6 probable	none	planned
Colombia	undecided	none	planned
Cuba	525/30/6	100,000	6, 2 building
Cyprus	unknown	unknown	none
Czechoslovakia	625/25/8	unknown believed small	1 experimental
Denmark	625/25/7	500	1, 1 planned
Dominican Republic	525/25/6	unknown believed 500	1
Egypt	none	none	planned
France	441/25/6 819/25/6	55,000	2, 1 building 5 planned
Germany (West)	625/25/7	1,800	2, 1 experimental
Germany (East)	625/25/variable	50	1
Great Britain	405/25/5	1,655,446 licensed	5, 2 planned
Guatemala	525/30/6 probably	none	planning
India	none	none	possible
Israel	none	none	studied
Italy	625/25/7	4,000	2, 11 planned
Japan	525/30	3,000	1 experimental, 10 planned
Mexico	525/30/6	37,500	4, more planned
Morocco	819/25/14	none	4 planned
Netherlands	625/25/7	7,000	1, 5 planned
Nigeria	unknown	unknown	possible
Norway	625/25/7	unknown	studied
Pakistan	undecided	none	studied
Poland	625/25/8 variable	unknown	experimenting
Saar	625/25/7 819/25/14	unknown	1 planned
Spain	625/25/7	125	3 planned
Sweden	625/25/7	100	experimenting
Switzerland	625/25/7	unknown	3 experimental
Tanganyika	unknown	unknown	possible
Thailand	undecided	unknown	1 planned
Turkey	625/25/7	none	studied
Uruguay	undecided	unknown	studied
U.S.S.R.	625/25/8	77,000	2 probable
Venezuela	625/25/6	unknown	1, 2 planned
Yugoslavia	625/25/7	unknown	3 planned

In addition to the countries listed in the preceding, American equipment manufacturers have received enquiries of a serious nature, regarding the establishment of TV, from the following countries: El Salvador, Republic of the Philippines, Peru, New Zealand, Costa Rica, Union of South Africa. Enquiries of a more casual nature have been received from: Honduras, Indonesia, Formosa, Greece, Malaya (Kaula, Lumpur, and Singapore).

The following countries have accepted TV Channel allocations under the EBU plan but have not reported any concrete action in TV:

Finland	625/25/7
Luxembourg	625/25/7
Vatican City	625/25/7
Albania	625/25/8
Bielorussia	625/25/8
Bulgaria	625/25/8
Hungary	625/25/8
Rumania	625/25/8
Ukraine	625/25/8
Monaco	819/25/14
Morocco	819/25/14
Tunisia	819/25/14

PROVEN LEADERSHIP
in Precision Communication Equipment!



NORTHERN RADIO
DUAL DIVERSITY RECEIVERS
—the choice of COMMERCE and the ARMED FORCES

Today, with transportation taking to the jet and far-flung armies moving on directives from half the world away, the need for precision communication equipment is indispensable. New highs in stepped-up speed, fidelity and dependability are demanded. Because Northern Radio specializes in the design and construction of Frequency Shift equipment of the types listed below, hundreds of Northern Radio equipments continue to meet this challenge.

For example, the Dual Diversity Receivers of the type pictured above under construction, although designed and built by Northern Radio for commercial use, have been specified *as is* by the Armed Forces.

This is *proven* communications leadership—and only constant research and precision manufacture can produce it. *Write for complete information.*

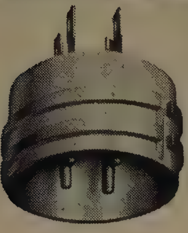
FREQUENCY SHIFT KEYERS
MASTER OSCILLATORS
DIVERSITY RECEIVERS
FREQUENCY SHIFT CONVERTERS
MULTI-CHANNEL TONE SYSTEMS
TONE KEYERS
DEMODULATORS
RADIO MULTIPLEX SYSTEMS
MONITORS
TONE FILTERS
LINE AMPLIFIERS

Pace-Setters in Quality Communication Equipment

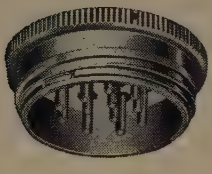
NORTHERN RADIO COMPANY, inc.
147 WEST 22nd ST., NEW YORK 11, NEW YORK

Theatre 3-210, IRE Show, March 25-26

CANNON PLUGS for hermetic sealed applications



KH



RKH

HERMETIC SEALED Type RKH Plugs and KH Receptacles mate with their corresponding Cannon RK and K standard fittings. The basic construction of fused vitreous insulation around the contacts is same as GS type. Shell materials and finish are likewise similar. Various types of flange or hex-bulkhead styles may be made to order.

Refer to KH-1 Section in K Bulletin.

SUB-MINIATURE receptacles of the new Cannon "U" Series are used on miniature switches, relays, transformers, amplifiers, and other sealed components, requiring a true hermetic seal or a connector of sub-miniature size with performance superiority.

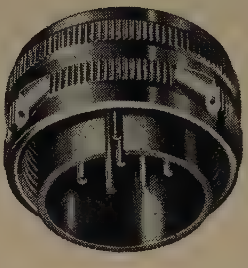
"U" plugs have a steel shell and "SILCAN*" insulator, cable relief and moisture resistant sleeve.

Bayonet-type locking means prevents vibration failure. Rated 1700v. d.c.; 5a. Available in 3, 6, and 12 contact arrangements with one plug style and two receptacles.

**Cannon Electric's special silicone resilient material.*

Refer to U-2 Bulletin

GS02



GS06

GS Types mate with standard AN(MIL) types. These highly successful hermetically sealed plugs (GS06) and receptacles (GS02) pioneered this field and are top quality fittings. Fused vitreous insulation provides a true hermetic seal for relays, position indicators, etc. Shells are steel, finished in cadmium plate and bleached Iridite; coupling nut on plug is natural finish Dural. Eyelet or solder pot terminals.

Built to resist thermal shock, −300°F. to +600°F., surpassing MIL Spec. GS02 Types will withstand operation temperatures 400°F. to 600°F., and pressures as high as 200 to 900 psi; specials to 7500 psi. GS Types approximate AN voltage and current ratings. Wide range of AN layouts available.

See GS-3 section in AN-8 Bulletin for details.

COMING: TYPE "DH" HERMETIC SEALED CONNECTORS SIMILAR TO PRESENT DA-15P

CANNON ELECTRIC

CANNON ELECTRIC

Since 1915

Factories in Los Angeles, Toronto, New Haven, Benton Harbor. Representatives in principal cities. Address inquiries to Cannon Electric Co., Dept. B-377, P.O. Box 75, Lincoln Heights Station, Los Angeles 31, Calif.

SECTION MEETINGS

AKRON

"Binaural Sound," by C. G. Baker, Magnecord, Inc.; December 9, 1952.

ATLANTA

"Magnetic Tape Recording," by R. A. Miner, Ampex Electric Corporation; November 21, 1952.

BALTIMORE

"Applications of Transistors," by Dr. Gordon Raisbeck, Bell Telephone Laboratories; December 10, 1952.

BINGHAMTON

"Advancements in UHF Television Broadcasting," by R. F. Stone, General Electric Company; November 18, 1952.

BUENOS AIRES

"Telecryptography," by Pedro Rozzi; September 19, 1952.

"The German Peoples TV Receiver (1938 Model)," by Jacobo L. Coriat; October 3, 1952.

"New Techniques in Alkaline Accumulators," by Angel B. Castaldi; October 24, 1952.

"Television Transmitting Plant," by Jacobo L. Coriat; November 7, 1952.

BUFFALO-NIAGARA

"A Correlation Computer," by E. W. Hix, Goodyear Aircraft Corporation; December 17, 1952.

CEDAR RAPIDS

"The Aerodynamics of Jet Propulsion," by Dr. Alexander Lippisch, Collins Radio Company; Film and Explanation on "Aircraft Landing Shocks Aboard a Naval Aircraft Carrier," by John A. Biggs, Collins Radio Company; December 17, 1952.

CHICAGO

"Kinescope Recording at WOI-TV," by L. L. Lewis; November 21, 1952.

CINCINNATI

"Voice of America in the Electromagnetic War," by G. Q. Herrick, U. S. Dept. of State; November 18, 1952.

COLUMBUS

"Corrosion in Action," by F. L. Laque, The International Nickel Company; November 12, 1952.

DALLAS-FORT WORTH

"Inspection Tour of Plant and Equipment—1,000,000 Watt A M Transmitter." Speaker: J. O. Weldon, Continental Electronics Manufacturing Company; December 11, 1952.

DAYTON

"Navigation in Outer Space," by John Wuerth, North American Aviation, and Demonstration of Binaural Sound by Mr. Wuerth; December 11, 1952.

DENVER

"Television in Denver," by Joseph Herold, KBTV; W. S. Law, McCollum Law Corporation; and W. E. Clyne, F.C.C.; November 21, 1952.

DES MOINES-AMES

"Modern Developments in Precision Oscilloscopes," by Eugene Shapiro, Everett Associates; November 18, 1952.

EL PASO

"TV in El Paso," by Edward Talbott, KROD-TV; December 12, 1952.

EMPORIUM

"Manufacture and Quality of Premium Subminiature Tubes," by R. W. Slinkman, Sylvania Electric Products, Inc.; November 18, 1952.

(Continued on page 82A)

ELECTRONICS AND EQUIPMENT

Electronic Tubes

Ruggedized Type Tubes

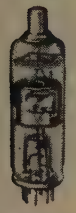
● The following tubes fully conform to JAN specifications and can be supplied promptly, usually direct from stock:

5R4WGY
6AL5W
6H6WGT
25Z6WGT

2D21W
OC3W
OD3W
2050W

TYPE 719-A HIGH VACUUM CLIPPER DIODE

This tube is used primarily for clipper diode service in hard tube modulator circuits. Filament 7 volts, 7 amps . . . Inverse peak anode voltage 25 kv, Max., peak anode current 10 amps, Max., anode dissipation 75 watts.



TYPE 1Z2 RECTIFIER

A small bulb high voltage vacuum rectifier. Low cathode heating power and low dielectric losses make tube suitable for radio frequency supply circuits. Filament 1.5 volts, .290 amps . . . Inverse peak anode voltage 20,000, average plate current 2 ma. . . . peak plate current 10 ma.

TYPE 1B46 REGULATOR

A cold cathode glow discharge tube designed for voltage stability. DC operating voltage 82 volts, operating current range 1 ma minimum, 2 ma maximum. Regulation 3 volts.

TYPE 395-A COLD CATHODE GAS TRIODE

Requires no filament supply and is used in many grid controlled rectifier and relay applications. Maximum D.C. anode current—10 ma. Maximum D.C. anode voltage—150 volts

TYPE 4B32 RECTIFIER

A rugged half-wave Xenon filled rectifier. Operates in any position throughout an ambient temperature range of −75°C to +90°C. Filament 5 volts, 7.5 amp . . . Inverse peak anode voltage 10,000 average anode current 1.25 amps.

TYPE 394-A THYRATRON

A Mercury vapor and Argon filled thyratron for grid controlled rectifier service. Operates over wide ambient temperature range. Heater 2.5 volts, 3.2 amps . . . Inverse peak anode voltage 1250, average anode current 640 ma.

TYPE 3B28 RECTIFIER

This rugged half-wave Xenon filled rectifier will operate in any position and throughout an ambient temperature range of −75°C to +90°C. Filament 2.5 volts, 5.0 amps . . . Inverse peak plate voltage 10,000, average anode current .25 amp.

Chatham Vacuum Switches

● TYPE 1S22 (illustrated) is a mechanically actuated, single-pole, double-throw, glass vacuum switch. This and other types can be supplied.

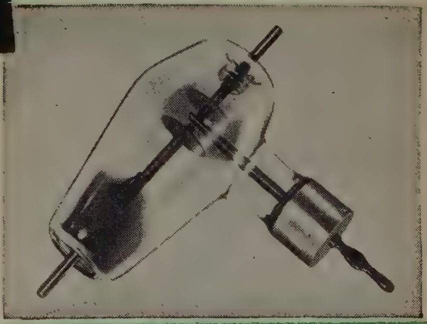
SPECIFICATIONS

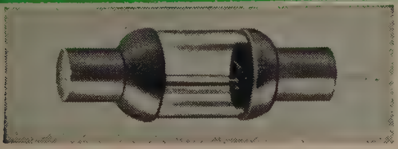
HOLD OFF VOLTAGE: Internal—10,000 volts rms; External* (at 27,000 feet altitude)—10,000 volts rms; External* (at 40,000 feet altitude)—7,500 volts rms.

INTERRUPTING RATING, RESISTIVE LOAD: 1,000 operations life at 10,000 v, ac, rms—10 amp, ac, rms; 1,000,000 operations life at 10,000 v, ac, rms — 2 amp, ac, rms; 500,000,000 operations life at 10,000 v, ac, rms—0.1 amp, ac, rms.

NET WEIGHT (approx.)..........2 ozs.
MAXIMUM LENGTH (overall)..........3⅝ ins.
MAXIMUM WIDTH (overall)..........4$\frac{1}{16}$ ins.
MAXIMUM THICK. (overall)..........1$\frac{9}{16}$ ins.

*at 50% humidity





HIGH VOLTAGE VACUUM FUSES

Can be supplied by Chatham to exact customers' specifications if ordered in adequate quantity. Call or write for full particulars and quotes.

CHATHAM ELECTRONICS CORP.

475 WASHINGTON STREET • NEWARK 2, NEW JERSEY

These American Electric

Miniatures do BIG jobs!

Cooling and Ventilating

CENTRIFUGAL BLOWERS

400 cycle, 60 cycle, or variable frequency types (320 to 1000 cps.)

Substantially flat output over full frequency range on variable frequency models with minimum watts loss.

Blower scrolls of latest design are molded of fibre-glass reinforced plaskon: practically unbreakable, highly resistant to impact, deformation, heat and cold. Blower unit unusually small in size and weight for compact installations. Generally used when working against pressure heads ranging up to 1.2" water. Single or double end blowers, Clockwise or Counterclockwise rotation. *Output range: 24 to 200 cfm. Made in sizes: Numbers 1½, 2, 2½, 3.*

AXIAL FLOW FANS

400 cycle operation

In its smallest size this compact, light weight unit is equipped with a 2" fan protected with 18" mesh 2¼" O.D. screen shroud. Other larger sizes special. Air stream is conical. Recommended for use at 0 static pressure where semi-directed air flow is required. Motor diameter 1.45". Rotation: Clockwise or Counterclockwise. *Output: 30 cfm.*

PROPELLER FANS—400 cycle operation

Built for limited space applications requiring maximum air movement widely dispersed.

Operates at 0 static pressure in ambient temperatures from −65° to +65° C. Made in 2, 3, 4 and 5½" fan diameters. *Output range: 33 to 680 cfm.*

Motivating Cams, Timing Devices, Antennas, Clutches, Optical Equipment, etc.

MINIATURE INDUCTION MOTORS

400 cycle, 60 cycle, single and poly phase, 2 to 8 pole. Frame diameters: 1.45", 1.75", 2", 2½" & 3-5/16". *Output torque range: ½ in. oz. to 50 in. oz.*

SYNCHRONOUS MOTORS

400 cycle, 60 cycle, hysteresis and reluctance types. Single and poly phase: 2, 4 and 6 pole. Frame diameters: 1.45", 1.75", 2", 2½", 3-5/16". *Output torque range: .01 in. oz. to 10 in. oz.*

Both induction and synchronous motors can be supplied for intermittent or continuous duty, with standard or high temperature insulation. Drive and synchronous motors: any standard shape.

Manufacturers also of
INSTRUMENTS,
SERVO-MOTORS AND
SYNCHROS,
HIGH FREQUENCY
POWER SUPPLIES
(Inductor—Alternator type—500 watt to 75 KVA output).

AMERICAN ELECTRIC MOTORS
TRADE MARK

4811 Telegraph Road,
Los Angeles 22,
California

SECTION MEETINGS

(Continued from page 78A)

EVANSVILLE-OWENSBORO

Presentation on "Radio Controlled Model Aircraft," by D. D. Mickey, General Electric Company; and "Sheet Beam Electron Tubes," by Dr. Robert Adler, Zenith Radio Corporation; November 12, 1952.

FORT WAYNE

"Application and Fabrication of Beryllium Copper Springs," by J. D. Roberson, Instrument Specialties Co., Inc.; December 4, 1952.

HAMILTON

"Electronic Digital Computers," by Dr. A. G. Ratz, Canadian Westinghouse Co. Ltd.; November 24, 1952.

Tour of Toronto Station CBLT; December 15, 1952.

HOUSTON

"A High Speed Analog Computer," by Sidney Kaufman, Shell Oil Company; September 16, 1952.

"The Conversion of Nuclear Energy Directly into Electrical Energy," by P. E. Ohmart, Ohmart Corporation; October 14, 1952.

Tour of New Long Distance Exchange Center Conducted by J. A. Matthews, Southwestern Bell Telephone Company; November 18, 1952.

INYOKERN

"Some Practical Aspects of Instrument Design," by Howard Vollum, Tektronix Inc.; November 18, 1952.

KANSAS CITY

"Control of the Electro Magnetic Radiation (Conelrad Project)," by E. C. Thelemann, Central Air Defense Force; December 1, 1952.

LITTLE ROCK

"Communication and Navigation Equipment for Aircraft," by James Hamilton, Collins Radio Corporation; November 19, 1952.

LONDON

"The Oxide Coated Cathode," by P. A. Redhead, National Research Council; December 1, 1952.

LOS ANGELES

"Subscription Television," by L. N. Ridenour, International Telemeter Corporation; December 2, 1952.

LOUISVILLE

"The Transistor—The Physics Thereof and Applications," by Dr. R. W. Sittner; December 12, 1952.

MILWAUKEE

"New Electronic Equipment," by Alfred Crossley; November 18, 1952.

"The Collins Mechanical IF Filter," by R. W. Callan, Collins Radio Company; November 20, 1952.

NEW YORK

"A New Junction Transistor for Higher Frequency Use," by L. G. Schimpf, Bell Telephone Laboratories; November 5, 1952.

NORTH CAROLINA-VIRGINIA

"Applied Ultrasonics," by Dr. Dudley Thompson, Faculty, Virginia Polytechnic Institute; November 21, 1952.

OMAHA-LINCOLN

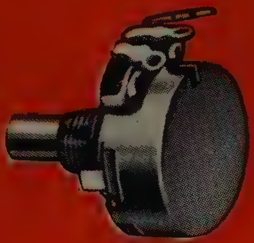
Discussion on Network Topology by Harold Becker, WOW-TV and KSWI; Discussion on Problems Involved in Increasing Power to E.R.P. of 100 KW at WOW-TV by William Kotera; December 8, 1952.

(Continued on page 86A)

COMPLETE MILITARY LINE

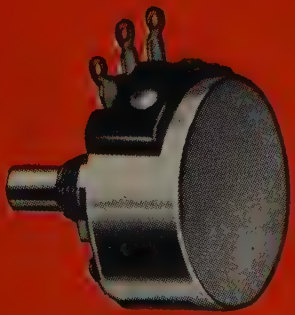
Immediate delivery from stock on 189 types including JAN-R-94 and JAN-R-19 types of variable resistors.

NEW 38-PAGE ILLUSTRATED CATALOG—
Describes Electrical and Mechanical characteristics, Special Features and Constructions of a complete line of variable resistors for military and civilian use. Includes dimensional drawings of each resistor. *Write today for your copy.*

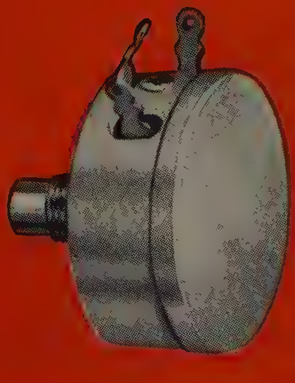


TYPE 45, (JAN-R-94, Type RV2)
1/4 watt, 15/16" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

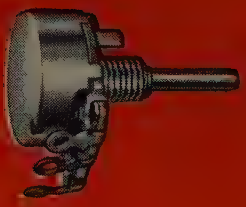
TYPE 35, (JAN-R-94, Type RV3)
1/2 watt, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.



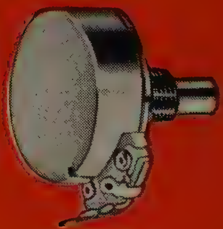
TYPE 252, (JAN-R-19, Type RA20)
2 watt, 1 17/64" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



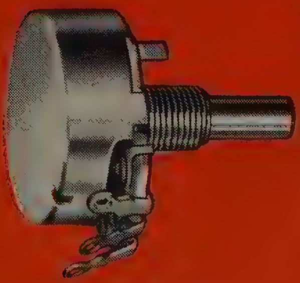
TYPE 25, (JAN-R-19, Type RA30)
(May also be used as Type RA25)
4 watt, 1 17/32" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



TYPE 65, (Miniaturized)
1/2 watt 70°C, 3/4" diameter miniaturized variable composition resistor.



TYPE 90
1 watt 70°C, 15/16" diameter variable composition resistor. Attached switch can be supplied. Also available in concentric shaft tandem construction.



TYPE 95, (JAN-R-94, Type RV4)
2 watt 70°C, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

See the complete CTS military and civilian lines of variable resistors at the

IRE SHOW

Grand Central Palace, New York City

MARCH 23-26, 1953

BOOTH 4-608

UNPRECEDENTED PERFORMANCE CHARACTERISTICS

Specially designed for military communications equipment subject to extreme temperature and humidity ranges. −55°C to +150°C...aridity to saturation.

CTS

CHICAGO TELEPHONE SUPPLY
Corporation

Primary Microphone Calibration in two weeks or less!

A unique service to the acoustic field by SHURE BROTHERS, Inc.

THESE ARE THE FACILITIES

Enlarged View of Hydrogen-Filled Coupler

Hydrogen-Filled Coupler and Integrated Reciprocity Calibration System Designed and Built at the Shure Laboratories

THIS IS THE STANDARD

A primary calibration service for condenser microphones, Type L (640A and 640AA), in accordance with the American Standard ASA Z24.4-1949. The frequency range covered is 50-15,000 c.p.s. Cross calibration is maintained with the National Bureau of Standards up to 10,000 c.p.s.

The cost is $65 net, time required is approximately 2 weeks. Your microphones for military use will be given special priority.

SHURE

For further information, write: Engineering Division

SHURE BROTHERS, Inc.
225 W. Huron Street
Chicago 10, Illinois
Cable Address: SHUREMICRO

SECTION MEETINGS

(Continued from page 82A)

OTTAWA

"Antennas for Circular Polarization," by Prof. George Sinclair, Faculty, University of Toronto; December 4, 1952.

"Microwave Relay System Between Buffalo and Montreal via Toronto and Ottawa," by A. J. Groleau, Bell Telephone Company; December 9, 1952.

PRINCETON

"Principles of Transistor Electronics," by R. R. Law, RCA Laboratories; and "Transistor Circuit Network Aspects," by R. J. Kircher, Bell Telephone Laboratories; December 11, 1952.

ST. LOUIS

"Transistors," by J. A. Doremus, Motorola, Inc.; October 30, 1952.

"Electronics in Nuclear Instrumentation," by Floyd Glass, Oak Ridge National Laboratories; November 13, 1952.

SAN DIEGO

"Instrument Landing Presentation," by D. F. Folland, Consolidated Vultee Aircraft Corporation; November 18, 1952.

SYRACUSE

"A Review of Bell Telephone Laboratories' Activities in Digital Computer Development," by E. G. Andrews, Bell Telephone Laboratories, Inc.; December 4, 1952.

TOLEDO

"Synthesized Speech," by Dr. W. G. Tuller, Melpar, Inc.; December 11, 1952.

TORONTO

"Practical Applications of Transistors," by J. R. Whyte, Canadian General Electric; December 8, 1952.

TWIN CITIES

"Color TV and the Three Color Tube," by C. N. Hoyler, R.C.A.; December 9, 1952.

SUBSECTIONS

LONG ISLAND

"Magnetic Resonance," by Dr. K. K. Darrow, Bell Telephone Laboratories; November 18, 1952.

MID-HUDSON

"Utilization of High Speed Movies in Industry," by J. H. Niemeyer, Eastman Kodak Company; November 17, 1952.

MONMOUTH

"Theatre Television," by F. M. Deerhake, General Electric Company; October 15, 1952.

"Recent Advances in Communication Techniques," by H. P. Corwith, Western Union; November 19, 1952.

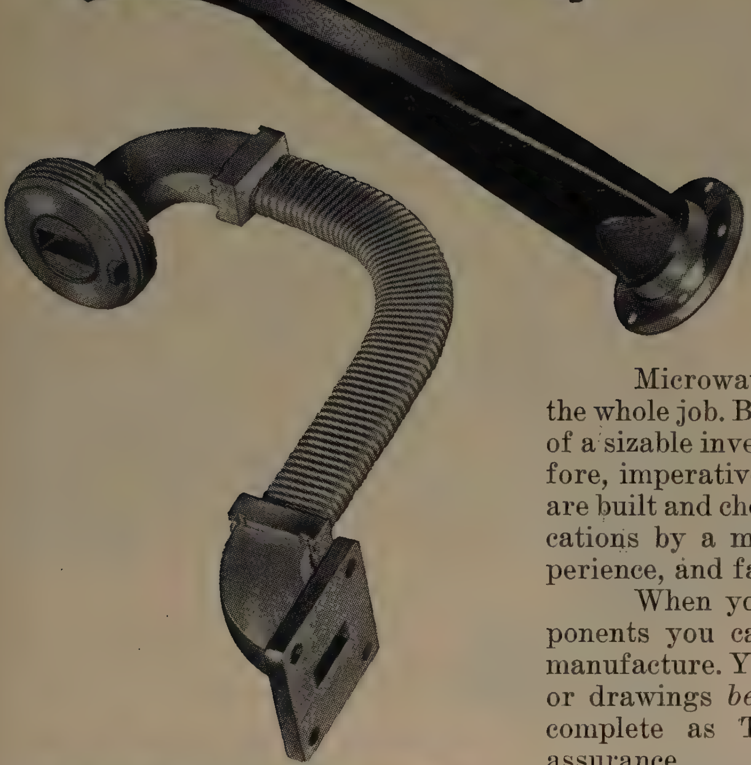
NORTHERN NEW JERSEY

"Concepts and Components for Modern Miniature Design," by Major Yale Jacobs, Wright Air Development Center, Ohio; November 12, 1952.

PALO ALTO

"Symposium on High-Power Microwave Measurement," by J. H. Jasberg, Stanford University; Bruce Nelson, Varian Associates; Herman Smith, Lytton Industries. Moderator: W. R. Hewlett, Hewlett Packard. October 29, 1952.

How to Get Microwave Components You Can Trust



Philco Xb Band Rigid Components receiving swept-frequency discrimination tests.

Microwave components are not costly in relation to the whole job. But they can make or break the performance of a sizable investment once they are installed. It is, therefore, imperative to see that your microwave components are built and checked precisely to your drawings or specifications by a manufacturer who has the knowledge, experience, and facilities to meet these requirements.

When you specify Titeflex Waveguides and components you can be confident of top craftsmanship in manufacture. You can be sure Titeflex will meet your specs or drawings *before* shipment. Only testing facilities as complete as Titeflex maintains could give you this assurance.

Titeflex inspection often saves you the time and cost of duplicate inspection. It is the final step in the production of custom-engineered, precision-manufactured microwave components.

Titeflex engineering and production facilities are available to help you solve your Microwave problems from original design to final production.

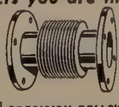
Milling the rubber-like compound which is subsequently molded over Titeflex flexible waveguides to protect them.

Have you this catalog of Titeflex microwave components? Use coupon in sending for your free copy.

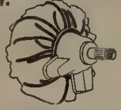
Let Our Family of Products Help Yours **Titeflex**

✓ *Check products you are interested in.*

☐ SEAMED AND SEAMLESS METAL HOSE

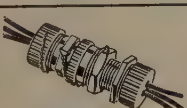


☐ PRECISION BELLOWS



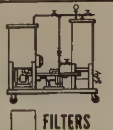
☐ IGNITION HARNESS

☐ IGNITION SHIELDING

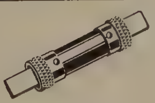


☐ ELECTRICAL CONNECTORS

☐ RIGID AND FLEXIBLE WAVE GUIDES



☐ FILTERS



☐ FUSES

TITEFLEX, INC.
511 Frelinghuysen Ave.
Newark 5, N.J.

Please send me without cost information about the products checked at the left.

MAIL COUPON TODAY

NAME________________

TITLE________________

FIRM________________

ADDRESS________________

CITY________ZONE____STATE____

B&W

Precise

AUDIO TESTING

for designing, production checking, research or "proof of performance" FCC tests for broadcasters.

A low-distortion source of audio frequencies between 30 and 30,000 cycles. Self-contained power supply. Calibration accuracy ±3% of scale reading. Stability 1% or better. Frequency output flat within 1 db, 30 to 15,000 cycles.

MODEL 200 . . . . **$138**

AUDIO OSCILLATOR

For fundamentals from 30 to 15,000 cycles measuring harmonics to 45,000 cycles; as a volt and db meter from 30 to 45,000 cycles. Min. input for noise and distortion measurements .3 volts. Calibration: distortion measurements ±5 db; voltage measurements ±5% of full scale at 1000 cycles.

MODEL 400 . . . . **$168**

DISTORTION METER

Combines RF detector and bridging transformer unit for use with any distortion meter. RF operating range: 400 kc to 30 mc. Single ended input impedance: 10,000 ohms. Bridging impedance: 6000 ohms with 1 db insertion loss. Frequency is flat from 20 to 50,000 cycles.

MODEL 404 . . . . **$85**

LINEAR DETECTOR

Speeds accurate analysis of audio circuits by providing a test signal for examining transient and frequency response . . . at a fraction of the cost of a square wave generator. Designed to be driven by an audio oscillator.

MODEL 250 . . . . **$10**

SINE WAVE CLIPPER

The instruments of laboratory accuracy

Bulletin PR-23 gives complete details

Barker & Williamson, Inc.

237 Fairfield Avenue • Upper Darby, Pa.

STUDENT BRANCH MEETINGS

UNIVERSITY OF ALBERTA, IRE-AIEE BRANCH

Film, "Adventures in Research"; November 20, 1952.

BROOKLYN POLYTECHNIC INSTITUTE, IRE BRANCH (DAY DIV.)

"Student Membership in the IRE-AIEE," by F. A. Wahlers, Faculty, Brooklyn Polytechnic Institute; October 7, 1952.

"Power Engineering," by F. A. Wahlers, Faculty, Brooklyn Polytechnic Institute; November 26, 1952.

"Problems in Recording, Audio," by C. J. Lebel, Audio Devices Inc.; December 2, 1952.

UNIVERSITY OF CALIFORNIA, IRE-AIEE BRANCH

"The Instrument Story," by Henry Berring, Weston Electrical Instrument Corporation; November 4, 1952.

"Electrical Engineering Options," by R. M. Saunders, O. J. Smith and Mr. Tajima, Faculty, University of California; November 21, 1952.

CARNEGIE INSTITUTE OF TECHNOLOGY, IRE-AIEE BRANCH

"Instrumentation," by R. J. Teetsel, Westinghouse Electric Corporation; November 15, 1952.

"Obtaining a Job and Engineer Registration," by Dr. Williams, Faculty, Carnegie Institute of Technology; November 20, 1952.

UNIVERSITY OF CONNECTICUT, IRE-AIEE BRANCH

"Transistors as Negative Impedance Elements," by Dr. John Linville, Bell Telephone Laboratories; November 20, 1952.

UNIVERSITY OF DENVER, IRE-AIEE BRANCH

Business Meeting; November 25, 1952.

"Television in Industry," by Dr. Webb, RCA Laboratories; December 1, 1952.

GEORGE WASHINGTON UNIVERSITY, IRE BRANCH

"Broadcast Receivers," by W. W. Balwanz, Naval Research Laboratory; December 3, 1952.

ILLINOIS INSTITUTE OF TECHNOLOGY IRE BRANCH

"Electronic Techniques and Equipment to Aircraft Power Systems," by S. C. Caldwell, General Electric Company; December 2, 1952.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, IRE-AIEE BRANCH

"Light Magic," by R. Wilson, General Electric Company; November 25, 1952.

MICHIGAN COLLEGE OF MINING AND TECHNOLOGY, IRE-AIEE BRANCH

"Brazil," by Mario de Goes, Student, Michigan College of Mining and Technology; November 18, 1952.

MICHIGAN STATE COLLEGE, IRE-AIEE BRANCH

"The Silicone Story," by Dr. Goodwin and "The Construction of a Power Transformer," by Dr. Ralston, both of General Electric Company; December 1, 1952.

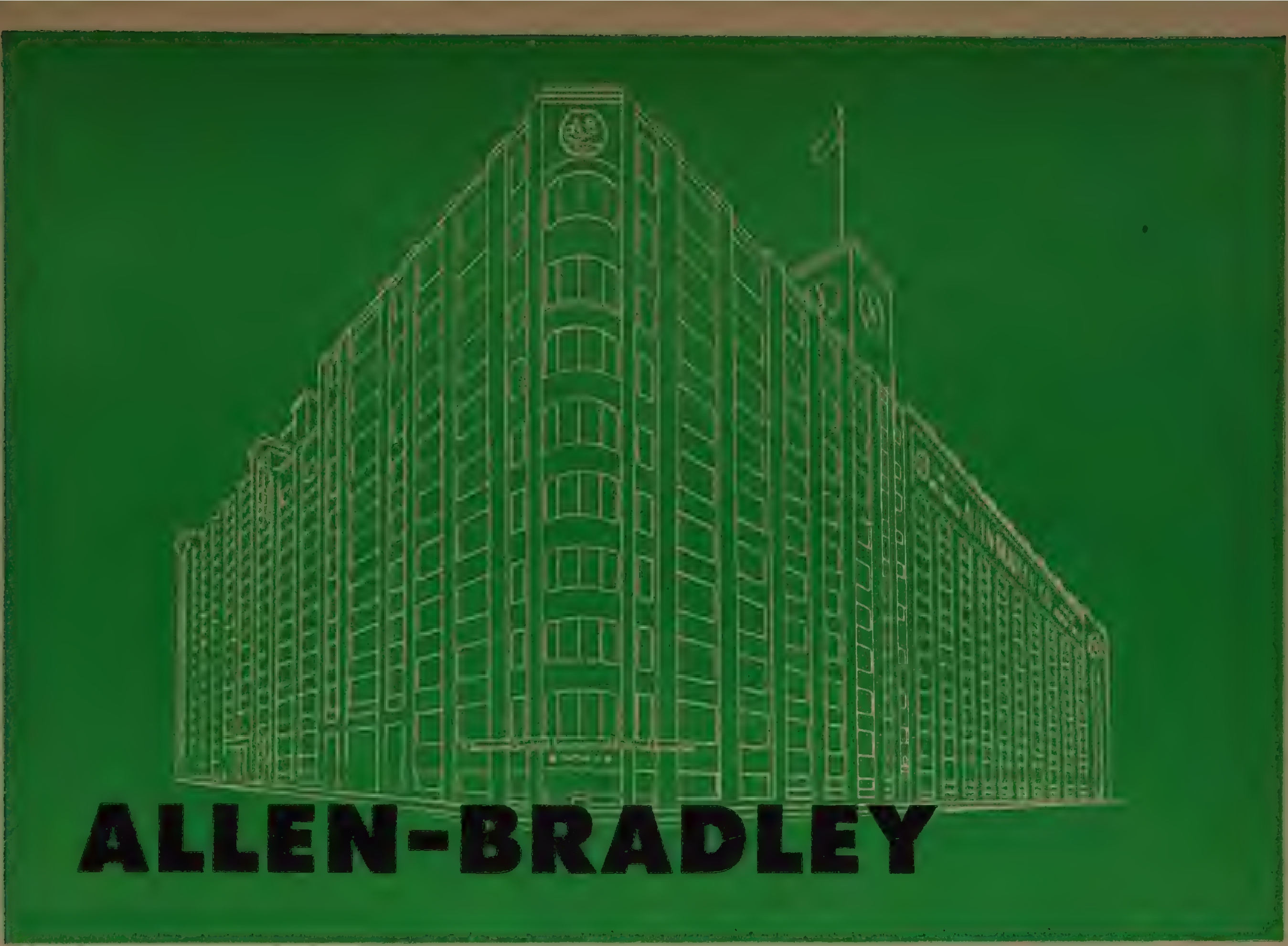
UNIVERSITY OF MINNESOTA, IRE-AIEE BRANCH

"Flicker Noise in Electron Tubes," by A. Van der Ziel, Faculty, University of Minnesota; November 25, 1952.

COLLEGE OF CITY OF NEW YORK, IRE BRANCH

"Transistors," by L. B. Valdes, Bell Telephone Laboratories; December 4, 1952.

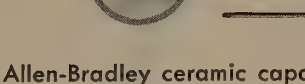
(Continued on page 90A)



ALLEN-BRADLEY

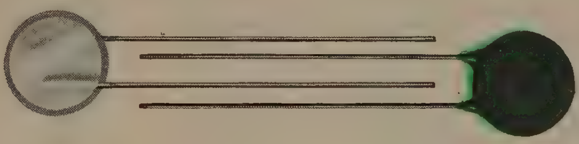
. . . A NEW AND DEPENDABLE SOURCE OF HIGH QUALITY CERAMIC CAPACITORS

If you use ceramic capacitors, you will be interested in Allen-Bradley as a source, because we make the entire capacitor, from the dielectric disc to the finished and tested unit. Send for samples for your qualification tests. Available from 0.001 to 0.01 microfarads.



Allen-Bradley makes its own Ceramic Discs

To assure dependable production and consistent capacitor quality, Allen-Bradley molds and sinters its own ceramic discs. All manufacturing processes are Allen-Bradley controlled.



Allen-Bradley ceramic capacitors are approved by the engineering departments of leading electronic, electrical, and telephone laboratories. Allen-Bradley . . . long famed for high quality electronic components . . . is at your service as a major supplier of ceramic capacitors of superlative quality.

Allen-Bradley Co., 114 W. Greenfield Ave., Milwaukee 4, Wis.

ALLEN-BRADLEY
RADIO & TELEVISION COMPONENTS
QUALITY

Allen-Bradley ceramic discs of high K dielectric material are molded by precision methods. After discs are sintered, silver paste is applied to each side and heat treated. After leads are soldered to silver surfaces, the capacitor is insulated and wax impregnated.

For the first time

FLEXIBLE WAVEGUIDE *with power rating equal to that of rigid guide!*

BANK ON Airtron inc. for

HIGH POWERED FLEXAGUIDE®

for **RADAR** applications

Broad-band FLEXIBLE assemblies guaranteed to a V.S.W.R. of less than 1.10—attenuation equal to that of brass rigid waveguide—yet none of the essential advantages of flexible plumbing sacrificed to achieve this new type of waveguide! Performance is what counts; let us show you . . .

NOW you can route your R.F. circuits into previously impossible channels, without power, V.S.W.R. or attenuation penalties

Write for data sheets on new, high powered **FLEXAGUIDE**

Airtron inc.

20 East Elizabeth Ave., Linden, New Jersey

BRANCH OFFICES
CHICAGO ST. LOUIS DAYTON DALLAS
BALTIMORE LOS ANGELES SEATTLE

STUDENT BRANCH MEETINGS

(Continued from page 88A)

NORTHEASTERN UNIVERSITY, IRE-AIEE BRANCH (DIV. A)

"Travalog on Italy and Switzerland," by Carl S. Ell, President of Northeastern University; October 30, 1952.

Field Trip to New Measurements Laboratory; November 6, 1952.

NORTHEASTERN UNIVERSITY, IRE-AIEE BRANCH (DIV. B)

"The Young Engineer in Industry," by Alvin Mandell, Ultrasonic Corporation; November 23, 1952.

"Graduate School for the Engineer," by Dr. H. K. Brown, Faculty, Northeastern University; December 4, 1952.

OHIO STATE UNIVERSITY, IRE-AIEE BRANCH

Film on Late Model North American Aircraft Developments and "Electrical Systems of Airplanes," by O. C. Rogers, North American Aviation Corporation; November 20, 1952.

OKLAHOMA AGRICULTURAL AND MECHANICAL COLLEGE, IRE-AIEE BRANCH

"Experiences in the Antarctic," by G. H. Bryant, Faculty, Oklahoma A. & M. College; December 8, 1952.

PENNSYLVANIA STATE COLLEGE, IRE-AIEE BRANCH

Film, "The Jet Story"; October 8, 1952.

"Transistors," by Robert Riddle, Faculty, Pennsylvania State College; November 12, 1952.

PRATT INSTITUTE, IRE BRANCH

"Digital Computers," by Mr. Mutter, International Business Machines; December 9, 1952.

PURDUE UNIVERSITY, IRE BRANCH

Election of Officers; November 11, 1952.

"Wave Guides," by W. H. Hayt, Faculty, Purdue University; November 19, 1952.

RUTGERS UNIVERSITY, IRE-AIEE BRANCH

Inspection Trip of the Naval Supply Depot and Salvage School, Bayonne, New Jersey; November 19, 1952.

Inspection Trip of the Broadcast Facilities and Equipment of W.C.T.C. Broadcasting Studios, New Brunswick, New Jersey, Conducted by Mr. V. Takash, Chief Engineer; November 24, 1952.

Film, "Manufacturing Impregnated Paper Insulated Cables"; December 4, 1952.

Inspection Trip of Motor Manufacturing Division, Diehl Manufacturing Company, Finderne, New Jersey, Conducted by Mr. F. Yates; December 8, 1952.

SAN JOSE STATE COLLEGE, IRE BRANCH

"Transistors," by Harry Engwicht, Faculty, San Jose State College; October 15, 1952.

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, IRE BRANCH

Film, "Aberdeen Proving Grounds"; November 20, 1952.

STANFORD UNIVERSITY, IRE-AIEE BRANCH

Field Trip to Harris J. Ryan High Voltage Laboratory and Demonstration by Dr. W. G. Hoover, Faculty, Stanford University; November 13, 1952.

UNIVERSITY OF TEXAS, IRE-AIEE BRANCH

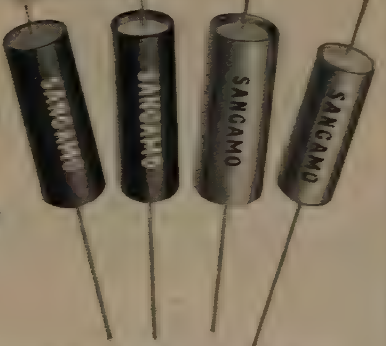
"Ideals of Life," by Mr. Jockel, Presbyterian Seminary; November 17, 1952.

"Symbolic Logic," by J. R. Kirk, Faculty, University of Texas; December 1, 1952.

(Continued on page 92A)

plenty papooses to choose from...

meet proposed MIL-C-25A Spec.



SANGAMO offers an exceptionally wide choice of subminiature paper capacitors in hermetically sealed metal cans!

There's no need to search for the right miniaturized hermetically sealed paper tubular capacitor for your application . . . You can choose from Sangamo's full range of capacities and voltages.

You have a choice of two impregnants—Sanowax for 85° C operation and Sangamo's amazing new E-therm for 85° C or 125° C operation. You can choose from two types of element construction —inserted tabs or extended foil . . . And, you can obtain all these capacitors with either grounded or insulated circuits.

These Sangamo subminiature paper capacitors, Types SA through SM, are sealed in non-magnetic cases, finished with a high tin content alloy. They are hermetically sealed with glass to Kovar, solder-seal terminals.

Complete information is yours in Engineering Bulletin TS-105. Write today.

The Little Indian

Those who know... choose Sangamo

SANGAMO
ELECTRIC COMPANY
MARION, ILLINOIS

SC53-4

Do you need

A RELIABLE AND
CONVENIENT MEANS
FOR CHECKING BOTH LEAKAGE
AND CONTINUITY OF ELECTRICAL
COMPONENTS?

SIE

MODEL C-3 RESISTANCE METER IS YOUR ANSWER

The Model C-3 Resistance Meter is designed for use by manufacturers in checking both leakage and continuity of electrical components. It is particularly valuable for making rapid checks of the insulation resistance of transformer windings, condensers, and electrical wiring as well as measuring the ohmic value of resistors and windings.

ELECTRICAL SPECIFICATIONS

ACCURACY: Plus or minus 3% of full scale deflection plus 1 ohm on the OHMS ranges.

Plus or minus 3% of full scale deflection (approximately 3 degrees) on the MEGOHMS ranges except 10[illegible] range.

Plus or minus 5% of full scale deflection on 10[illegible] megohms range.

RANGES: 1 ohm to 1 million megohms

The ohmmeter applies a maximum of 1½ volts to the resistor under test. It has a scale of from 0 to 500 ohms and a selector switch for selecting scale multipliers of x 1, x 10, x 10[illegible], and x 10[illegible].

The leakage tester applies a maximum of 125 volts to the unit under test. Its scale reads from 1 to [illegible] megohms and has multipliers of [illegible] x 1, x 10, x 10[illegible], x 10[illegible] and x 10[illegible].

SOUTHWESTERN INDUSTRIAL
ELECTRONICS COMPANY

Scientific minds at H. H. Buggie. And Company are constantly at work with electronic

research

to make possible advanced

design

and outstanding features of

engineering

all of which is supplemented by skilled craftsmanship in

manufacturing

to provide outstanding products including . . .

CONNECTORS, CABLE ASSEMBLIES and COMPONENTS for America's electronics industry

AN Types
RF Types
Rack and Panel
Cable Assemblies

IN ADDITION to the products listed above, H. H. Buggie And Company designs, engineers and manufactures many *special parts and assemblies* for companies in the field of electronics. We invite your inquiries.

H. H. BUGGIE
And Company
TOLEDO 4, OHIO
Sales Engineers in All Principal Cities

Skilled in Electronic Component Parts
RESEARCH · DESIGN
ENGINEERING ·
MANUFACTURING

Student Branch Meetings

(Continued from page 90A)

TUFTS COLLEGE, IRE-AIEE BRANCH

"Microwave Systems," by G. M. Harford, New England Telephone and Telegraph Company; November 19, 1952.

UTAH STATE AGRICULTURAL COLLEGE,
IRE BRANCH

Film, "The Antenna is the Pay-Off," Provided by Channelmaster Corporation; December 10, 1952.

VIRGINIA POLYTECHNIC INSTITUTE,
IRE-AIEE BRANCH

"Qualities for an Engineer," by D. H. Miller and "Field Engineering," by S. L. Buckman, both students, Virginia Polytechnic Institute; November 11, 1952.

"Jet Engines," by Mr. Wall, General Motors Corporation; November 18, 1952.

"Socialism in the Electrical Industry," by George Barnes, Faculty, Virginia Polytechnic Institute; November 25, 1952.

"Microwave Magic," by T. E. Martics and R. N. Marshall, Western Electric; December 2, 1952.

General Meeting; December 9, 1952.

UNIVERSITY OF WASHINGTON, IRE-AIEE BRANCH

Business Meeting and Film, "Operation Crossroads"; October 10, 1952.

"Electrical Indicating Instruments," by Henry Berring, Weston Electrical Instrument Corporation; October 23, 1952.

Field Trip to the Skagit-Ross Dam; November 1, 1952.

WORCESTER POLYTECHNIC INSTITUTE,
IRE-AIEE BRANCH

"The Engineering of the Continental Microwave Relay System," by H. W. Evans, Bell Telephone Laboratories; December 11, 1952.

YALE UNIVERSITY, IRE-AIEE BRANCH

"Non-Linear Circuit Phenomenon," by J. Cunningham, Faculty, Yale University; November 25, 1952.

"Basic Principles of Pulse Communication," by H. L. Krauss, Faculty, Yale University; December 9, 1952.

MEMBERSHIP

(Continued from page 31A)

Hughes, F., 250 Woodbury Rd., Huntington, N. Y.
Isenson, R. S., 5107 Guido Dr., El Paso, Tex.
Jones, W. D., Box 3344, USAFIT, Bldg. 125, Wright-Patterson AFB, Ohio
Kegel, A. G., Westinghouse Electric Corp., Friendship International Airport, Baltimore, Md.
Kovasznay, L. S. G., Department of Aeronautics, Johns Hopkins University, Baltimore 18, Md.
Leoni, A. J., Park Central Hotel, 443 W. Wrightwood Ave., Chicago 14, Ill.
Marsh, M. D., 142 D Haddon Hills, Haddonfield, N. J.

Mueller, H. W., 4995 Lannoo, Detroit 36, Mich.
Pitinsky, L., 1406 Kipling Dr., Dayton, Ohio
Reyes, C. M., Box 1623, Station D, Los Angeles 7, Calif.
Schiffmacher, E. R., Sacramento Peak Rt., Cloudcroft, N. Mex.
Shay, J. A., 425 N.W. 121 St., Miami, Fla.
Smith, S. E., Box I, University Station, Austin, Tex.

(Continued on page 94A)

This remarkable relay protects against overloads ...has inverse time delay...

Here is an overload relay that combines extremely high speed operation under dangerous conditions with inverse time delay to allow for starting inrush or harmless, momentary overloads.

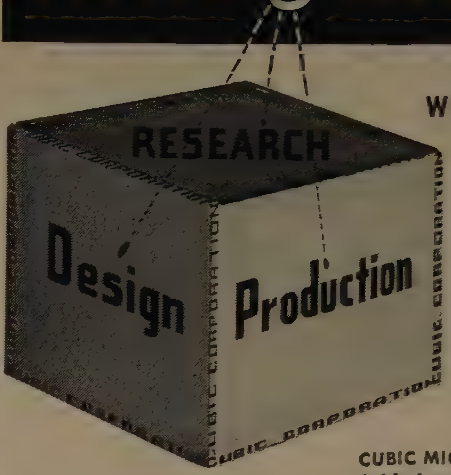
HEINEMANN Silic-O-Netic® Overload Relays put protection on a definite basis. They always carry the rated load regardless of ambient temperature ... always actuate with time delay at 125% of rating ... always actuate instantaneously at eight times rating.

This degree of performance available only in HEINEMANN Silic-O-Netic Overload Relays allows you to build-in the positive protection of your products.

Send for Bulletin 5101.

HEINEMANN
ELECTRIC COMPANY
154 PLUM STREET • TRENTON 2, N. J.

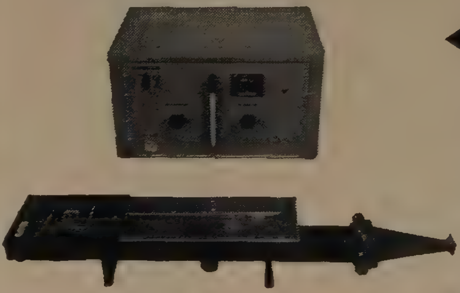
CUBIC'S 3 SIDED COVERAGE



PROVIDES YOU WITH THE WORLD'S FINEST PRECISION

- **MICROWAVE & RADAR COMPONENTS**
- **ELECTRONIC INSTRUMENTS & TEST EQUIPMENT**

CUBIC MICROWAVE ENGINEERS—specialists in the field since the inception of Radar in World War II—start with electronic problems and ideas, and convert them into the most accurate precision-built electronic instruments and equipment! We welcome inquiries—not only in connection with our rapidly developing list of products—as represented below—but on ideas, problems, or design of microwave assemblies of your own specification you may want developed and produced.



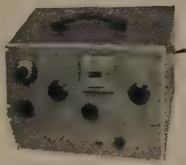
MICROWAVE CALORIMETRIC WATTMETER

portable ... for lab and field use ... to measure absolute microwave power.

Frequency Range: 2600 MC to 26500 MC
Max. VSWR: 1.1
Max. Peak Power: 600 KW

COAXIAL CALORIMETRIC WATTMETER

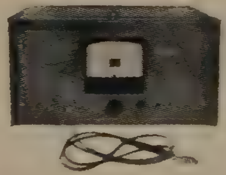
Frequency Range: 200 MC to 3000 MC—Max. VSWR: 1.5 over range—Max. Peak Power: 1⅝″ Coaxial rating



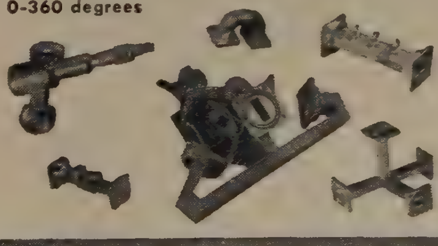
MICROWAVE (X-BAND) PULSE MEASURING WATTMETER

for measuring peak power of microwave pulses from signal generators or radar systems.

ELECTRONIC DIRECT-READING PHASE METER



Frequency Range: 20 to 50,000 cycles
0-360 degrees



Shown at left are a few of our standard microwave components available as catalog items. Special purpose wave guide assemblies designed to customer's specs can also be produced.

CUBIC CORPORATION

SCOTT & CANON STS.
SAN DIEGO 6
CALIFORNIA

Devoted Exclusively to Electronics & Electronic Equipment

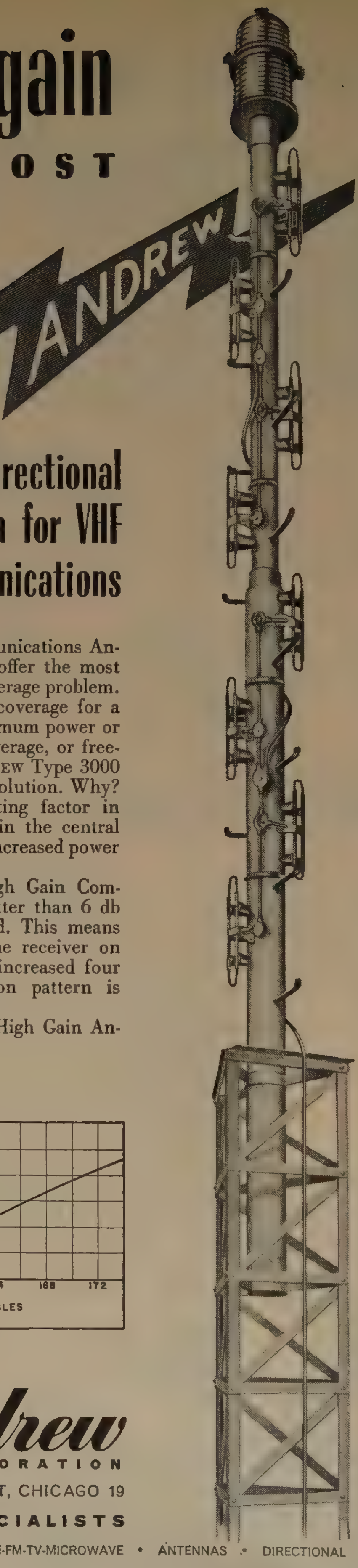
high gain
LOW COST

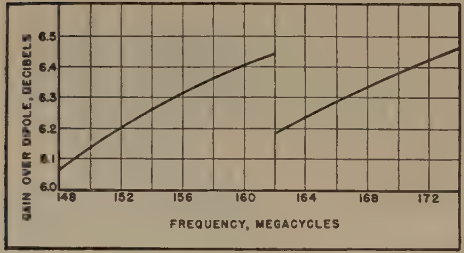
Andrew Omnidirectional Antenna for VHF Communications

No, this new High Gain Communications Antenna isn't cheap, but it does offer the most economical solution to your coverage problem. Whether you want maximum coverage for a specific transmitter power, minimum power or shortest tower for a specific coverage, or freedom from dead spots, the ANDREW Type 3000 Antenna is the least expensive solution. Why? Because talk-back is the limiting factor in mobile communications. Gain in the central station antenna costs less than increased power in every mobile unit.

ANDREW Type 3000 High Gain Communications Antenna offers better than 6 db gain in the 148-174 MCS band. This means that the power delivered to the receiver on both talk-out and talk-back is increased four times. The horizontal radiation pattern is circular.

Write for the ANDREW High Gain Antenna bulletin today!





Andrew
CORPORATION
363 EAST 75TH STREET, CHICAGO 19
ANTENNA SPECIALISTS
TRANSMISSION LINES FOR AM-FM-TV-MICROWAVE • ANTENNAS • DIRECTIONAL ANTENNA EQUIPMENT • ANTENNA TUNING UNITS • TOWER LIGHTING EQUIPMENT

(Continued from page 92A)

Stanphill, J. R., 7424 Gaston Ave., Fort Worth, Tex.
Sullivan, C. L., Jr., 7310 Dunkirk Rd., Houston 21, Tex.
Winters, B. C., 6501 Olympic Pl., Los Angeles 35, Calif.

The following elections to Associate grade were approved and are effective as of January 1, 1953:

Albro, P. W., 823 F St., Newport News, Va.
Anderson, H. P., 101 Yeager Ave., Forty Fort, Pa.
Armstrong, N. A., R.D. 1, Holland Patent, N. Y.
Arnold, E. N., 2405 Whipple Rd., S.W., Canton, Ohio
Autery, R. M., Battelle Memorial Institute, 505 King Ave., Columbus, Ohio
Avery, S., Jr., 295 Wolcott Hill Rd., Wethersfield, Conn.
Baghurst, W. F., 637 E. Broad St., Souderton, Pa.
Bailey, J. M., R.D. 4, Perry, Okla.
Bakeman, O. R., 105 Linwill Terr., Syracuse 6, N. Y.
Baker, G. M., 4247 N. Kenmore Ave., Chicago 13, Ill.
Beagan, W. J., 285 Madison Ave., New York 17, N. Y.
Beane, G. F., Jr., 4426 Mason Ave., Chicago 30, Ill.
Bertsch, R. A., 118 Bagshaw Rd., Columbus, Ohio
Bills, R., 3609 Elmley Ave., Baltimore 13, Md.
Boyages, A., 106 Nicholas St., Everett, Mass.
Brate, D. C., 803 Vischer Ave., Schenectady, N. Y.
Brooks, R. E., 1018 Rose Ave., Piedmont, Calif.
Brown, H. K., 414 N. 41 St., Belleville, Ill.
Bubb, W. J., 1924 S. Volutsia, Wichita, Kans.
Buckley, J. K., 5051 N. Kenmore St., Chicago 40, Ill.
Burlingame, C. W., 604 N. 12, Mt. Vernon, Ill.
Cadena, D. G., 599 Broadview Dr., W., San Antonio, Tex.
Caplan, D. I., Burroughs Adding Machine Co., 511 N. Broad St., Philadelphia, Pa.
Capozzi, R. V., 173 Mill St., Poughkeepsie, N. Y.
Carter, P. G., 3063 Anzio, Dallas, Tex.
Carlson, K. L., 1335 Oakland Rd., N.E., Cedar Rapids, Iowa
Charron, J. H. A., 459 Cairnsmore St., Winnipeg, Man., Canada
Christian, W., Caixa Postale 12470, Jpiranga, Sao Paulo, Brazil
Clark, R. N., AA & BM Br., Box 72, Fort Bliss, El Paso, Tex.
Cochran, J. L., 2839 N. Tacoma St., Arlington, Va.
Cohen, S., 18 Sands Walk, Brooklyn 24, N. Y.
Cordova, P. A., H. Escobar 30, Caibarien, L. Villas, Cuba
Cox, J. C., 2211 Jefferson St., Prentis Park, Portsmouth, Va.
Coy, L. M., Jr., 1027 Felbar Ave., Torrance, Calif.
Cunningham, A. B., 525 Telfer St., Winnipeg, Man., Canada
Daggett, E. H., 1327 Alcott Ave., Dayton, Ohio
D'Airo, J., 2289 Coney Island Ave., Brooklyn 23, N. Y.
Davis, G. H., Jr., Rm. 2031, Bldg. 11, National Bureau of Standards, Washington 25, D. C.
Deacon, F. W., 79 Cornelius Pkwy., North Park, Ont., Canada
Demieville, H., Swissvale, 2035 Lafayette St., Pittsburgh 18, Pa.
Devalle, M., Via delle Rosine 17, Torino, Italy
Dieterich, E. J., 44 Grant Ave., Watertown 72, Mass.
Ellis, R., Federal Telecommunications Laboratories, Nutley, N. J.
Erni, J. B., 1801 Key Blvd., Arlington, Va.
Evans, B. O., Springwood Village, Apt. 6-A, Hyde Park, N. Y.

(Continued on page 97A)

MEMBERSHIP

(Continued from page 94A)

Faraone, J., 275 Stillwell, Kenmore, N. Y.
Feder, J. H., Keystone Products Co., 904—23 St., Union City, N. J.
Feltman, A. V., 95-02 Waltham St., Jamaica, L. I., N. Y.
Fisher, R. E., 1198 Chestnut St., Newton Upper Falls 64, Mass.
Fling, J. J., 5736 Lexington Ave., Los Angeles 38, Calif.
Fox, D. W., 1800 S.E. 39 St., Portland 15, Ore.
Fukuhara, K. K., 1948 W. Huron, Chicago, Ill.
Gedance, A. R., 206 W. Beaver Ave., State College, Pa.
Geist, G. W., 5736 N. Rockwell, Chicago, Ill.
Goldstein, I., 8611 Bay Pkwy., Brooklyn, N. Y.
Green, M., 2439 Delware Ave., Buffalo 16, N. Y.
Gross, L. S., 18th Fl., Inquirer Bldg., Philadelphia, Pa.
Gunderson, H. A., R.D. 2, Box 2430-A, Edmonds, Wash.
Gunn, C. R., 290 N.E. 129 St., North Miami, Fla.
Hancharek, J., 855 Bannatyne Ave., Winnipeg, Man., Canada
Hanson, L. W., 621 W. Parr Ave., Campbell, Calif.
Harokopus, W. P., 407 Brown Ave., N.W., Canton, Ohio
Hayden, F. L., 2613—39th St., N.W., Washington 7, D. C.
Hennings, H. H., 5255 N. Mason Ave., Chicago, Ill.
Hicks, J. J., 4521 Osage Ave., Philadelphia 43, Pa.
Hicks, W. S., 207 Indian River Ave., Melbourne, Fla.
Hill, N. R., 55 E. Second St., Moorestown, N. J.
Horde, J. W., 39 E. Garfield Blvd., Chicago 37, Ill.
Hoye, W., 350 Seven Oaks Ave., Winnipeg, Man., Canada
Hreczuch, S. F., 61 Inman Ave., St. Vital, Man., Canada
Hutton, L. I., 641 S. Pinecrest, Wichita, Kans.
Ingwersen, D. N., 7-B Porter Blvd., 34 & Broadway, Kansas City, Mo.
Jackson, D. H., 3004 E. Murdock, Wichita, Kans.
Janakos, N., 1516 Cottage Grove Ave., San Mateo, Calif.
Jenkins, B., Jr., Carolina Power & Light Co., Raleigh, N. C.
Jensen, D. C., 78 N. 11 St., Newark 7, N. J.
Kanter, L. E., Lab. Annex, I.B.M., Poughkeepsie, N. Y.
Kay, R. H., 48 Northrup Pl., Buffalo 14, N. Y.
Keely, A. W., 2 Butler Lane, Levittown, L. I., N. Y.
Keith, W. W., Concord Rd., R.D., South Sudbury, Mass.
Kieshalier, F. W., 7 Alexander St., Warren, Pa.
Kipp, C. F., 852 Princes Ave., London, Ont., Canada
Krell, A. I., 64 Powderhorn Rd., Bridgeport, Pa.
Kruse, J. E., 3236 Irving Ave., S., Minneapolis, Minn.
Kurtz, S. K., High Power Station, Annapolis, Md.
Laas, I. E., 740 Riverside Dr., New York 31, N. Y.
Lane, T. B., Jr., 1618—21 St., N.W., Washington, D. C.
Leeds, M., 105-05—69 Ave., Forest Hills, L. I., N. Y.
Lombardini, P. P., 924 S. 49 St., Philadelphia, Pa.
Long, F., 6549 Harvey Ave., Merchantville 8, N. J.
Loring, L. W., 9212 Woodhall, Detroit 24, Mich.
Lyons, R. E., 3063 S. Woodrow St., Arlington, Va.
Macdonald, C. J., 457 Stuart St., Boston 16, Mass.
Maidak, A. M., 6240 Waveland Ave., Chicago 34, Ill.
Marchand, O. P., Keystone Products Co., 904—23 St., Union City, N. J.
Maurice, F., Des Machines Bull, 94 Ave. Gambetta, Paris, France
May, J. P., 4410 Fourth Rd., N., Arlington 3, Va.
McAlister, W. H., 575 Barry Lane, Beaverton, Ore

(Continued on page 98A)

Write for
ACE SCREEN ROOM GUIDE

Contains latest data on ACE shielded enclosures, an analysis of attenuation versus frequency measurement techniques, and suggestions for obtaining maximum shielded enclosure efficiency. Ask for Bulletin 3.

ACE Cell-Type SHIELDED ENCLOSURES (SCREEN ROOMS)

9 OUT OF 10
R-F SHIELDED ENCLOSURES
(SCREEN ROOMS)
USED TODAY IN MEETING
EXACTING SPECIFICATIONS
JAN-I-225, 16E4 (SHIPS), MIL-I-6181 etc.
WERE MADE BY
ACE

GUARANTEED to produce a minimum attenuation of 100 db from 0.15 to 1000 mc., and to closely approach this attenuation at 10,000 megacycles.

PRE-BUILT, ready to install. Easy to enlarge or to relocate.

CELL TYPE or single shielded rooms for any requirement.

USED by top-ranking military and civilian equipment producers and laboratories throughout the world.

ACE ENGINEERING and MACHINE CO., INC.
3644 N. Lawrence St., Philadelphia 40, Pa. Telephone: REgent 9-1019

NRK
Microwave Assemblies, Radar Components, and Precision Instruments . . . manufactured to your Blueprints and Specifications.

N.R.K. MFG. & ENGINEERING CO.
4601 WEST ADDISON STREET • CHICAGO 41, ILL. • SPring 7-2970

AGASTAT

Compact . . . Dust-Proof
TIME DELAY RELAYS
solenoid actuated—pneumatically timed

Introduces time delays into a-c or d-c circuits. Easily adjusted to provide delays ranging from 0.1 second to five or more minutes.

The AGASTAT is small, light, and operates in any position. Dust-proof timing chamber assures long operating life with a minimum of maintenance.

Write for Bulletin.
Dept. A1-27,

AGA

Division of Elastic Stop Nut Corporation of America
1027 Newark Avenue, Elizabeth 3, New Jersey

Membership

(Continued from page 97A)

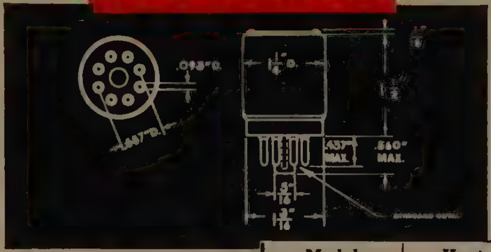
McKee, G. R., Jr., Bell Telephone Laboratories, Inc., Holmdel, N. J.
Melcher, R. J., 726 Stanton St., Toledo 4, Ohio
Merritt, J. E., 4 Emory St., Jersey City 4, N. J.
Metzmaier, M. E., 1368 S. Fourth St., Columbus 7, Ohio
Meyer, B. W., Box 3337, MCLI, USAFIT, Wright-Patterson AFB, Ohio
Miller, E. O., 345 South St., Morristown, N. J.
Miura, A., 417½ O St., Sacramento 14, Calif.
Moore, J. A., 1043 W. 104 St., Los Angeles 44, Calif.
Morris, W. P., Bendix Radio, McClellan AFB, Sacramento, Calif.
Morrison, R. F., Jr., 2428—18 St., S.E., Washington, D. C.
Myszko, R., 1053 Wilmington Ave., Apt. 17, Dayton, Ohio
Nicholson, J. F., 632 E. King St., Lancaster, Pa.
Nowlin, D. K., 11250 Barry Ave., Melrose Park, Ill.
O'Neill, E. P., 64-66—82 St., Jackson Heights, L. I., N. Y.
Oseas, J., 39 Maple Grove Apts., W. Bayard St., Seneca Falls, N. Y.
Ossenbeck, F. J., Sig. Sec., Hq. AFFE, APO 343, c/o PM, San Francisco, Calif.
Oswald, J. A., 606 W. Calverley, Houghton, Mich.
Paniker, B. S. K., 57 Government Quarters, Dover Lane Ext., Calcutta, India
Parmenter, E. W., 1103 North Rd., Belmont, Calif.
Pearlman, R. R., 780 West End Ave., New York 25, N. Y.
Perkins, P. H., 5146 Ellsworth St., San Diego 10, Calif.
Perry, S. G., 530 Trent Ave., E. Kildonan, Man., Canada
Peterson, D. A., 751 Sherwood Ave., St. Paul 6, Minn.
Prusha, G. J., 10966 Lawndale Dr., Parma Heights, Ohio
Quinby, R. E., Butternut Hollow Rd., Greenwich, Conn.
Reel, W. R., 1839 Godfrey Ave., Philadelphia, Pa.
Rickerson, D. M., 630 N. Oakland, Arlington, Va.
Roderick, W. P., Jr., 1901 S. Knoxville, Tulsa, Okla.
Rogers, H. D., 805 S. Lincoln, Kirksville, Mo.
Rohn, W. B., 122 Cutter Mill Rd., Great Neck, L. I., N. Y.
Rosenberg, M., 136 E. 88 St., Brooklyn, N. Y.
Ross, R. H., 4 Wainwright St., Dorchester, Mass.
Sattem, I., Remington Rand, Inc., Wilson Ave., South Norwalk, Conn.
Saunders, N. T., Metal Fabricators Corp., 73 Pond St., Waltham, Mass.
Scammell, R. E., 1403 Portage Ave., Winnipeg, Man. Canada
Schneider, H. L., 201 W. Prospect Ave., State College, Pa.
Schreiber, W. B., Jr., 6158 Liebig Ave., New York, N. Y.
Sedor, W. J., 6250 N. Glenwood Ave., Chicago 40, Ill.
Shaler, D., 24-49—27 St., Long Island City, L. I., N. Y.
Sharp, D. W., R. D. 3, Box 156, Fairfax, Va.
Shellito, H. H., 1671 W. 14 St., Erie, Pa.
Sher, A., The Okonite Co., Passaic St., Passaic, N. J.
Siegmann, M. J., 140-25 Ash Ave., Flushing, L. I., N. Y.
Simpson, P. A., Rm. 2031 Industrial Bldg., U. S National Bureau of Standards, Washington 25, D. C.
Slager, D. M., 1315 St. Paul St., Baltimore, Md.
Smith, C. R., Radio Station CKWX, 543 Seymour St., Vancouver, B. C., Canada
Sweet, M. E., Box 504, Apalachin, N. Y.
Syphax, W. T., 1327 S. Queen St., S., Arlington, Va.
Tarrant, S. R., Niles Contractor School, White Sands Proving Ground, Las Cruces, N. M.
Ten-Cate, W. L., 7900 Temple Rd., Philadelphia, Pa.

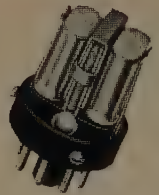
(Continued on page 100A)

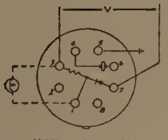
FOR EXTREME STABILITY.. *Bliley* CRYSTALS PLUS *Bliley* TEMPERATURE STABILIZERS

Crystal frequency stability is a finite factor determined by ambient temperature variation. Bliley Temperature Stabilizers, used with Bliley Crystals, are thermostatically controlled ovens engineered to deliver extreme stability regardless of ambient temperature changes.

TCO SERIES







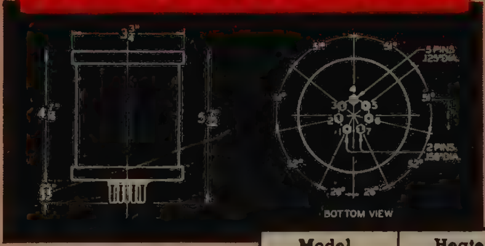
BOTTOM VIEW OF BASE

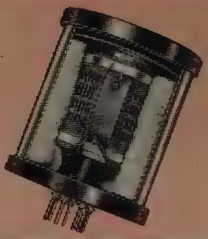
Designed specifically for use with Bliley types BH6A and SR11 crystal units. Standard models are supplied as indicated:

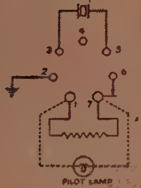
NOTE: BROKEN LINES INDICATE CONNECTIONS IF PILOT LAMP IS USED IN CIRCUIT TO SHOW WHEN HEATER IS ENERGIZED

Model	Heater Voltage	Watts	Crystal Sockets	Control Temperature
TCO-1A	6.3	5.5	1	75°C or 85°C
TCO-1C	24 or 26.5	7.75	1	75°C or 85°C
TCO-2	6.3	5.5	2	75°C
TCO-2	6.3	7.9	2	85°C
TCO-2D	24 or 26.5	7.75	2	75°C or 85°C

TYPES TC911-TC92-TC93







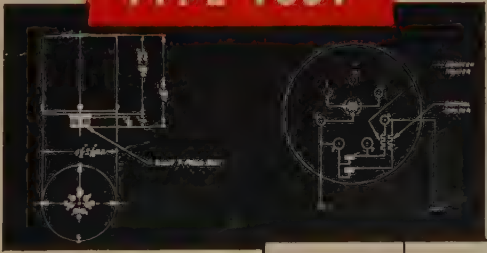
Designed specifically for use with Bliley Crystal units. Standard models are supplied, for crystal types, as indicated:

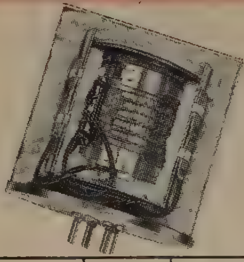
Model	Heater Voltage	Watts	Crystal Group	Control Temperature
TC911	115	10	B	70°C
TC92	6.3	10	A	60°C
TC93	18	10	A	60°C

Crystal Group A Types FM6, BH81A, MC7, AR4, AR5

Crystal Group B Types BH8, MC75, MS46A

TYPE TC97





Exceptional temperature stability is provided by two separate heaters, individually regulated by separate thermostats. Ambient temperature variations are first minimized by outer stage (booster) heater with final regulation by inner stage (control) heater.

Model	Heater Voltage	Watts	Crystal Group	Control Temperature
TC97	6.3	11	A	75°C

Crystal Group A Types FM6, BH81A, MC7, AR4, AR5

BLILEY ELECTRIC COMPANY

UNION STATION BUILDING, ERIE, PENNSYLVANIA

TRANSFORMERS

HERMETICALLY SEALED
TO MIL-T-27 SPECIFICATIONS

NYT offers a wide variety of transformer types to meet military and civilian specifications, designed and manufactured by specialists in transformer development.

Latest NYT service for customers is a complete test laboratory equipped and approved for on-the-spot MIL-T-27 testing and faster approvals.

NEW YORK
TRANSFORMER CO., INC.
ALPHA, NEW JERSEY

Membership

(Continued from page 98A)

Thomen, M. K., 1309 Smilax St., Fort Worth 11, Tex.
Thompson, R. T., Jr., 2298—17 St., N. W., Washington, D. C.
Thorpe, C. R., 2642 Stamford Dr., Toledo, Ohio
Tromblay, R. H., 246 Windsor Dr., Fayetteville, N. C.
Troster, M., 20 Beaumont Cir., Tuckahoe, N. Y.
Trott, G. G., 1181 Sherman Ave., New York 56, N. Y.
VanHorne, J. L., 90 Holton, Danvers, Mass.
Velasco, F. C., 7835 S. Harvard, Los Angeles, Calif.
Verdibello, A. A., 126 DeHart Pl., Elizabeth, N. J.
Waddell, B. L., 1926 Ontario St., Burbank, Calif.
Walder, E., Hofwiesenstrasse 35, Zurich 57, Switzerland
Walker, K. A., 106 S. Lancaster St., Reynoldsburg, Ohio
Wallace, G. R., 400 Smithfield Ave., Winnipeg, Man., Canada
Walton, P. S., Jr., 1518 Lyons St., Lansing, Mich.
Ward, B. L., Jr., 2002 Fordham St., Hyattsville, Md.
Ward, F. E., 520 S. Maple, Harrison, Ark.
Wasson, H. M., 544 Oakside Pl., Woodbury, N. J.
Welborn, D. L., 1009 W. 81 St., Kansas City 5, Mo.
Wiesendanger, M. U., 45 W. 45 St., New York 36, N. Y.
Wightman, C. W., Jr., 48 E. Royal Pkwy., Williamsville, N. Y.
Winter, R. J., 4821 Renville, Detroit 10, Mich.
Woerndel, E., 4550 Moore St., Beaumont, Tex.
Wong, S. Y., Electronic Computer Project, Institute for Advanced Study, Princeton, N. J.
Woodruff, D. L., 30 Whittingham Pl., West Orange, N. J.
Zimmerman, A. A., 4916 Magnolia, Chicago 40, Ill.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 12A)

Small Capacitor

The development of a new, molded paper capacitor, the world's smallest, for continuous operation at temperatures up to 125°C has just been announced by the **Sprague Electric Co.,** 235 Marshall Street, North Adams, Mass.

Designated Type 85P, these capacitors are impregnated with Prokar, an exclusive high temperature organic material which is polymerized to a solid resin. The resulting dielectric is completely solid and permits considerable size reduction with extreme stability under all operating conditions. The impregnated sections are then molded in a mineral-filled, high temperature plastic.

Originally developed for military use, these miniatures are now available for precision electronic equipment requiring high quality components such as electronic computers and geophysical amplifiers. Type 85P units are available in 2 mold sizes, 0.175 inch diameter by $\frac{3}{8}$ inch long and 0.200 inch diameter by $\frac{5}{8}$ inch long. Standard RTMA 20 per cent and 10 per cent capacitance decade values are available as well as 5 per cent values at slightly extra cost.

Bulletin 205E, showing standard sizes, ratings, and performance data, will be sent upon letterhead request.

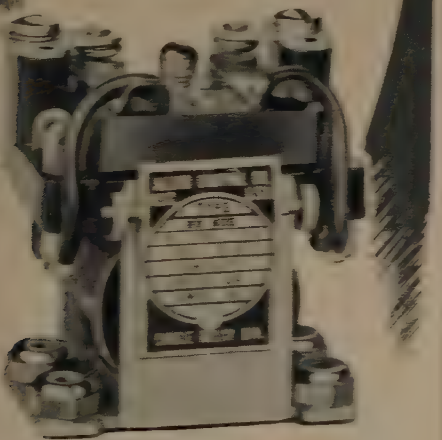
(Continued on page 102A)

24 HOUR DELIVERY FROM STOCK!

RELAYS

Our stock of more than a million relays — in over a thousand different types — is the world's largest. Don't delay your production for want of large or small quantities of relays of any type.

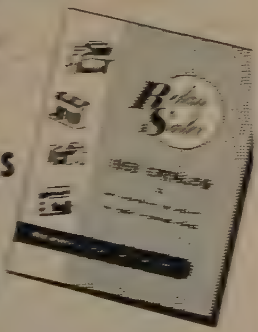
Telephone, wire or write for quotations.



NEW AND MORE COMPREHENSIVE

1953 RELAY SALES CATALOG

NOW READY

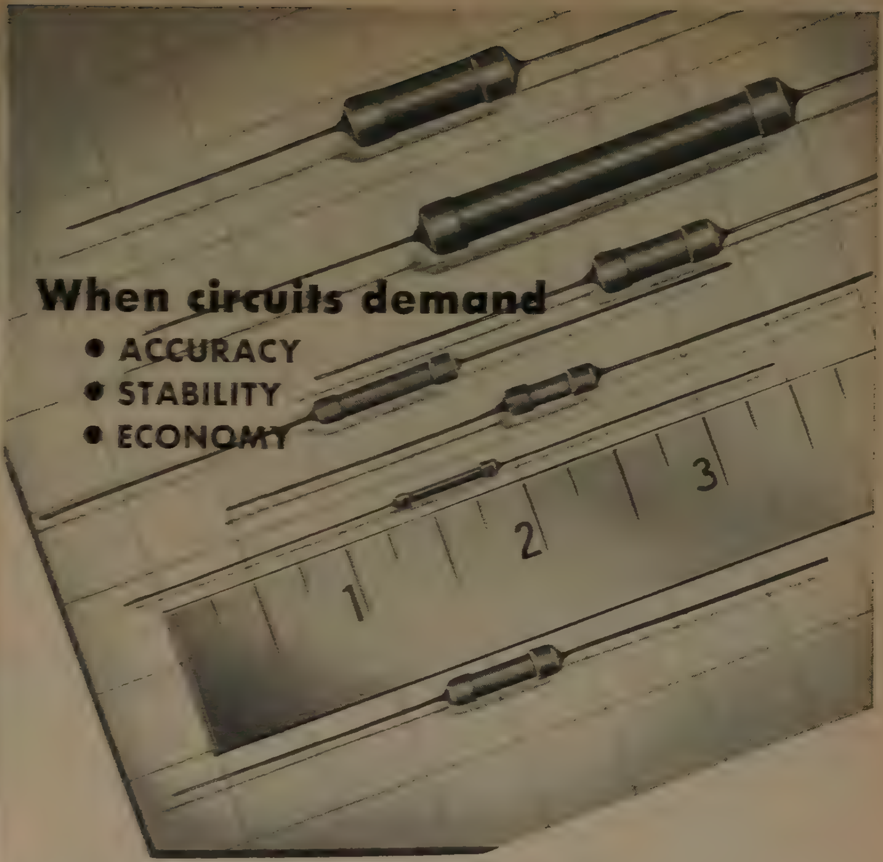


Be sure to send for your copy

Relay Sales

Telephone
SEeley 8-4146

833 W. CHICAGO AVE.
DEPT. 2, CHICAGO 22, ILL.



When circuits demand

- ACCURACY
- STABILITY
- ECONOMY

use ELECTRA deposited carbon resistors

For Your ±5% Requirements You Can Get "1%" STABILITY At Real Economy!

Manufacturers have long needed the stability and small size of deposited carbon resistors for their ±5% applications. Now—Electra makes these available to you at economical prices.

Just imagine—you only pay for ±5% tolerance but you get the same stability characteristics you would get in ±1% or ±½% resistors. And small size! You can use Electra resistors where many others fail to fit.

There are five standard sizes in a wide range of values to choose from.

Resistor	Wattage	Resistor Dimension Length	Resistor Dimension Diameter	Lead Dimension Length	Lead Dimension Diameter
DC-½	.5	13/16"	[illegible]/64"	1½"	.032"
DC-½A	.5	19/32"	[illegible]/64"	1½"	.032"
DC-½B	.5	[illegible]	5/64"	1½"	.032"
DC-1	1.0	[illegible]	[illegible]/32"	1½"	.032"
DC-2	2.0	2-[illegible]	[illegible]/32"	1½"	.032"

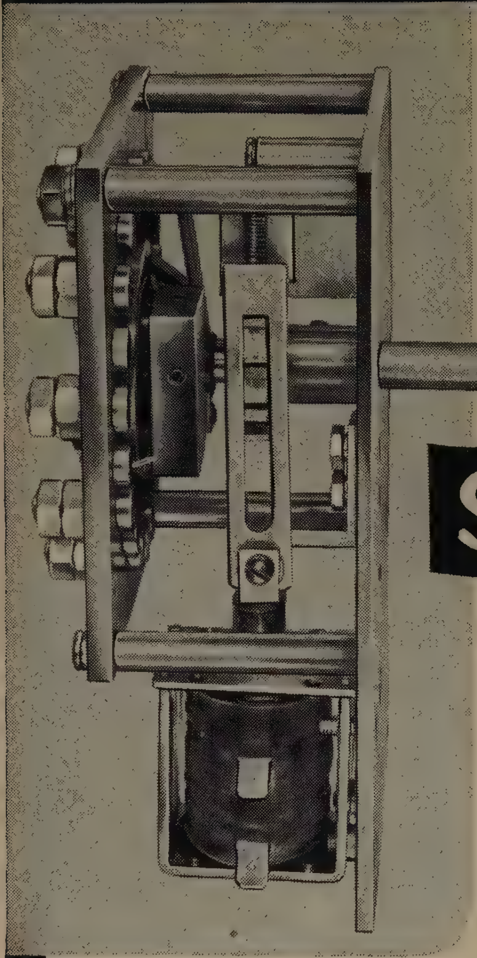
Also available to meet your requirements

- ⅛ watt and ¼ watt resistors
- Hermetically-sealed resistors
- Special coatings and special sleeves

Electra
carbon-coat
PRECISION RESISTORS

Consult factory about your special requirements

ELECTRA MANUFACTURING CO.
2537 Madison
Kansas City 8, Mo.



Ruggedly Designed for Dependable, Heavy-Duty Operation

TECH LABS SOLENOID OPERATED SWITCHES

When operating conditions demand a solenoid switch that will stand up under the most rugged requirements, always choose Tech Laboratories Solenoid Switches. These multi-pole units are built to "take it" and are designed and produced to meet your individual requirements.

According to your specifications you can get:

- Remote push-button operation, with or without manual reset.
- Single or dual direction operation.
- Single, or up to 8 decks.
- Single pole to 4 poles per deck.
- Two contacts up to several hundred contacts per deck.
- Shorting or non-shorting.
- Ceramic or phenolic insulation.
- Load capacities up to 10 Amp.—120 Volts AC (depending on number of contacts).
- Long, trouble-free service life.

Information on these and our additional line of motor operated switches is yours for the asking . . . Write today for complete catalog.

TECH LABORATORIES, INC.

Manufacturers of Precision Electrical Resistance Instruments

PALISADES PARK, NEW JERSEY

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 100A)

Small Oscillators

Two new wide-range RC oscillators of extremely compact size and simple operation were announced this month by the **Hewlett-Packard Co.,** 395 Page Mill Rd., Palo Alto, Calif.

The new instruments, Models 200AB and 200CD, have high stability and accurate, quickly resettable tuning circuits. Operation is simplified, and only three front panel controls are used.

Model 200AB, for general audio tests, offers a frequency range of 20 cps to 40 kc, 1 watt output. Model 200CD, for wide-range measurements at lower power levels, provides constant voltage output from 5 cps to 600 kc. An output amplifier provides complete isolation of the load, and changes in output load do not change oscillator performance. Frequency stability is better than ±2 per cent including warmup, and hum voltage is less than 0.1 per cent rated output. Model 200AB is priced at $120.00, and Model 200CD is $150.00 f.o.b. factory.

Six Channel Amplifier

Yellow Springs Instrument Co., Inc., Yellow Springs, Ohio, has a new six channel amplifier unit (Model 201-A) that is a portable (69 pounds complete with power supply), self-contained system used primarily for the measurement of strain, pressure, acceleration, vibratory displacement, and velocity.

Model 201-A consists of six individually excited, three-stage, single-channel amplifiers, with output metering and overload

(Continued on page 104A)

KENYON

TRANSFORMERS for standard and special applications

Designed by specialists of 25 years standing • Engineered to exact specifications • Tested for peak performance • Constructed to outlast their guarantee • Kenyon transformers meet all Army-Navy specifications.

KENYON TRANSFORMERS FOR

- MIL Applications
- Radar
- Broadcast
- Atomic Energy Equipment
- Special Machinery
- Automatic Controls
- Experimental Laboratories

Write for details

KENYON TRANSFORMER CO., Inc.
840 Barry Street, New York 59, N. Y.

NEW miniature damped control motor type 17 ID....

...for servo and instrument applications

SERVOMECHANISMS, Inc. Type 17ID2-8 is a balanced 2-phase, 26-volt, 5500-RPM, 400-cycle damped induction motor employing a drag cup and an axially adjustable magnet to achieve velocity damping. This design provides for variable and smooth linear velocity damping and lower operating temperature. The desired degree of viscous damping is achieved by operating setscrew adjustment.

* * *

The non-damped induction control motor 1712-8 of 8,000 RPM is also available.

FEATURES OF DAMPED CONSTRUCTION DESIGN INCLUDE

- Cogless Damping
- Zero Residual Noise Signal
- Constant Damping
- Lower Inertia
- Lower Cost

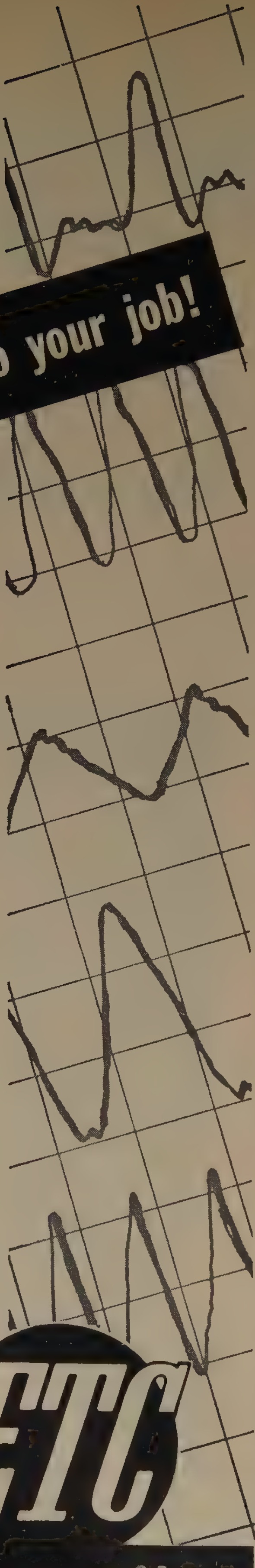
Write to Dept.-CLO-3 for specific information on motors.

OTHER INSTRUMENT MOTORS

..... Hysteresis Synchronous design, Type 17H1-8 for 26 volts and Type 19H for 115 volts in speeds of 8,000, 12,000, and 24,000 RPM are available for various applications. Special windings and external shaft configuration can be provided on request.

SERVOMECHANISMS INC.
WESTBURY, L. I., N. Y.

EL SEGUNDO, CAL., NEW CASSEL, N.Y.



when

a single 'scope won't do your job!

Anytime two or more different—but related—phenomena must be measured at the same time . . . under the same conditions . . . more and more engineers and scientists are finding that multi-channel oscilloscopes are the only economically sound answer.

No other equipment can give them such correct time relationships for a number of simultaneous phenomena. No other equipment saves the array of instruments and varying test procedures required by other means of coincident analysis, nor gives them such a convenient photographic record.

Speed and vibration . . . input and output signals of circuits . . . displacement time with associated dynamic strains and pressure . . . or even the relation between brain waves and muscular potentials are just a few of the many applications being discovered daily. Are you missing an opportunity in your field?

If your problem is multi-fold, chances are there's an ETC multi-channel oscilloscope that can do the job. Standard 'scopes are available in 2, 4, 5, 6, 8 or even 10 channel models. ETC also produces many special models for specific uses. A free catalog describing these 'scopes and tubes will gladly be sent upon request. Write today.

ETC

electronic tube corporation

1200 E. MERMAID LANE, PHILADELPHIA 18, PA.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

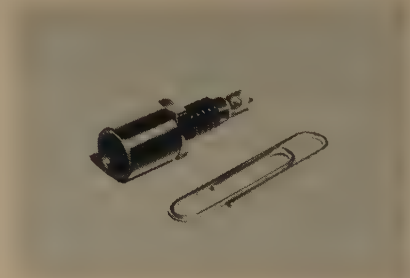
(Continued from page 102A)

indicating circuits and with linear and integrated amplification employed to provide for the use of a wide variety of pickup devices, and a separate electronically regulated power supply.

Power line requirements are 115 ±15 volts. Frequency is 60 to 400 cps. Input is 250 microvolts to 0.25 volts. Impedance is 100,000 ohms, one side grounded. Output is 1.2 volts rms maximum undistorted. Impedance—Maximum output load should be 250,000 ohms shunted by 100 $\mu\mu$f. Amplification is 4,000. Frequency response is flat within: 0.5 db from 10 cps to 50 cps; 0.1 db from 50 cps to 10 kc; 0.5 db from 10 kc to 15 kc; 2.0 db from 15 kc to 30 kc.

Test Point Jack

Alden Products Co., 117 North Main St., Brockton, Mass., has a new, skirted test-point jack (Model 110BCSH) that permits from the front of equipment panels safe circuit voltage readings up to 3,000 volts ac peak. Its high collar, compared to that of a low-voltage jack, protects operators from flash-over during high-voltage checks. Actual flashover breakdown to chassis occurs at 7–8,000 volts ac rms.



This jack has a beryllium copper contact, with an adequate, pre-tinned soldering tab suitable for use up to 14 gauge wire. Because it is a punch press terminal with proper heat transfer characteristics, soldering is rapid and thorough. This property of rapid heat transfer also prevents destruction of such dielectrics as nylon by reducing necessary exposure to heat to a minimum.

For good heat resistance and aging characteristics plus low water absorption, this jack, which is molded from phenolics conforming with JANP-14 MTS-E1 and MIL-P 14A-CFG, is recommended. Material to these specifications can be had in black, red, and brown. Other colors in phenolic units are available, blue, green, and tan. If insulating specifications are not critical, the test jacks can be furnished in nylon, in similar brilliant colors.

For details contact Nelson Hearn at the Company.

(Continued on page 106A)

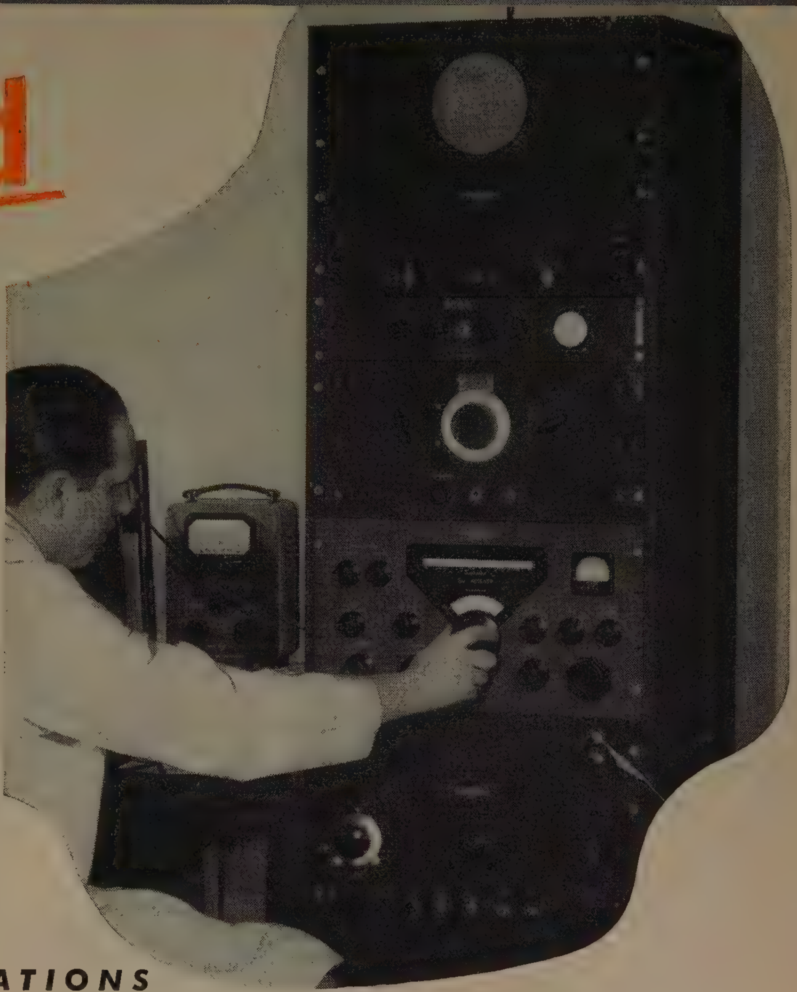
LABORATORY TEST EQUIPMENT

Unexcelled

in

- ★ **Accuracy**
- ★ **Dependability**

The COLLINS 51J
Communications Receiver



The Collins 51J Communications Receiver in addition to its outstanding performance in the communications field, is being widely used in industrial laboratories as a sensitive and accurate measuring instrument and as a spectrum analyzer. Write for complete specifications and details today.

CONDENSED SPECIFICATIONS

FREQUENCY RANGE:
.54 to 30.5 megacycles.

TYPE OF CIRCUIT:
Double Conversion Superheterodyne.

CALIBRATION:
Direct reading in megacycles and kilocycles. One turn of main tuning dial covers 100 kilocycles on all bands.

TUNING:
Linear, divided into 30—one mc bands.

FREQUENCY STABILITY:
Overall stability within 1 kc under normal operating conditions.

SELECTIVITY:
5.5 to 6.5 kilocycles wide at 6 db down. 17 to 20 kilocycles wide at 60 db down.

AUDIO OUTPUT:
4 and 600 ohms impedance. 1 1/2 watts at 1000 cps with less than 15% distortion overall. "S" meter may be switched to read audio output.

RF INPUT:
High impedance single-ended. Break-in relay mounted internally. Antenna trimmer will resonate input circuit when used with any normal antenna.

POWER REQUIREMENTS:
85 watts 45/70 cps, 115 volts or 230 volts by reconnection on power transformer.

DIMENSIONS:
Panel — 10 1/2 inches high, 19 inches wide, notched for rack mounting. Optional metal cabinet — 21 1/8 inches wide, 12 1/4 inches high and 13 1/8 inches deep. Speaker available in metal cabinet 15 inches wide, 10 5/8 inches high and 9 1/8 inches deep.

For excellence in radio communications equipment, it's . . . COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 W. 42nd St., NEW YORK 36
1930 Hi-Line Drive, DALLAS 2
2700 W. Olive Ave., BURBANK

SECON

DEVELOPMENT and PRODUCTION
METALLURGISTS

Fine wire and ribbon in base, rare, and precious metals, and alloys for new and highly engineered applications. In small units and sizes, and to close tolerances.

Further details on request.

SECON

SECON METALS CORPORATION
228 East 45th Street, N. Y. 17, N. Y., MU 7-1594

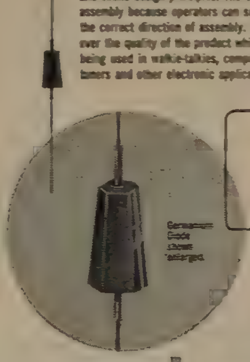
Flying Saucers?

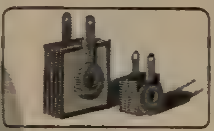
Frankly we don't know if they're fact or fiction . . . but if they *are* fact it wouldn't surprise us a bit to learn that some extra-terrestrial manufacturer has incorporated SELETRON Selenium Rectifiers and R. R. Co. Germanium Diodes into the design.

That's because—as pioneers in the field of electronic development—we've had our hand in some of the most difficult projects and met some of the stiffest requirements ever cooked up! Making drawing board dreams come true are daily chores at Radio Receptor Co.!

RR GERMANIUM DIODES

Radio Receptor's new Germanium Diodes feature polarity at a glance combined with simplicity of construction and sound design principles. The tapered shape speeds assembly because operators can see at a glance the correct direction of assembly. Users are enthusiastic over the quality of the product which is currently being used in walkie-talkies, computers, TV sets, tuners and other electronic applications.





Seletron

SELENIUM RECTIFIERS

Seletron Selenium Rectifiers, in both miniature and industrial types, are in constant demand by an increasingly large number of engineers throughout the world because they are completely dependable under the most grueling conditions. Years of experience have given Radio Receptor Co. a deep insight into the idiosyncrasies of rectification.

Our Germanium Diodes and Seletron Selenium Rectifiers may hold the answer to many of your problems. Radio Receptor Engineers will be glad to study your requirements and submit their recommendations on both of these products.

Germanium Transistors available in limited quantities.

Seletron and Germanium Division

RADIO RECEPTOR COMPANY, Inc.

RR Since 1922 in Radio and Electronics RR

SALES DEPT: 251 West 19th Street, New York 11, N. Y. • FACTORY: 84 North 9th Street, Brooklyn 11, N. Y.

News—New Products

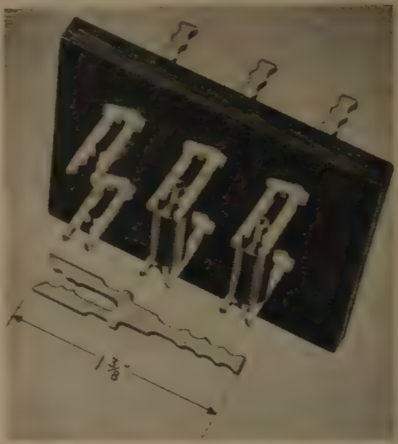
These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 104A)

Diode Clip

A new diode clip that permits quick, easy insertion and removal of diodes has been developed by **Computer Research Corp.**, 3348 W. El Segundo Blvd., Hawthorne, Calif.

The new clips are structurally stronger than present clips, and will accommodate most types of diodes now in use. They require no rivets or other fasteners for mounting. The clip is simply pressed into a hole on the diode board as shown below. Spring tension holds the diode securely in the clip, and a special plating assures good surface contact.



Other advantages of the new clip include greater ease in removing defective diodes, faster assembly of diode boards, and quicker initial check-out of finished equipment. They also facilitate preventive maintenance tests and the keeping of performance records on individual diodes. Where a large number of diodes are used, such as in computers or radar equipment their features result in important savings of time and money.

For further information or prices please write to the Director of Applications, Computer Research Corp.

New Oscilloscope

A new Oscilloscope developed by **Electronic Measurements Corp.**, 280 La-

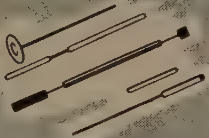
(Continued on page 108A)

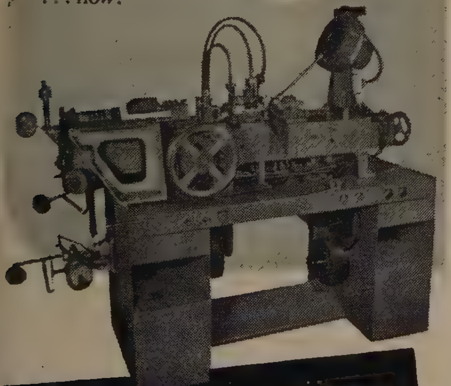
Here's how to get production quantities of precision components for TRANSISTORS RADIO TUBES HERMETIC SEALS LAMPS

Now it is possible for progressive manufacturers to produce their own precision electronic components. For example, the Automatic Lead Wire Welding Machine, shown below, was recently designed and built by Kahle to produce 12,000 3-piece leads per hour for miniature receiving tubes. Although this machine, Model 2148, is designed to make standard welds, it is but one step from a machine to produce leads for electronics' latest wonder . . . the transistor. In addition, Kahle has produced a fully automatic Filament Making and Tabbing Machine, Model 2036, that produces from 1,200 to 3,000 filaments per hour depending upon wire diameter.

These machines reflect Kahle's ability to design and build special-purpose machinery to meet any given specifications. Regardless of your current production problems, learn . . . without obligation . . . how Kahle's more than 40 years of practical experience can benefit you.

For specific information, write Kahle . . . now.





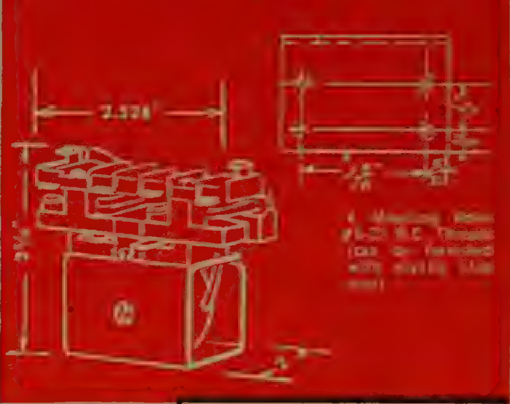
Kahle

ENGINEERING COMPANY
1312 SEVENTH STREET
NORTH BERGEN, N. J.

New Phil-trol Relay!

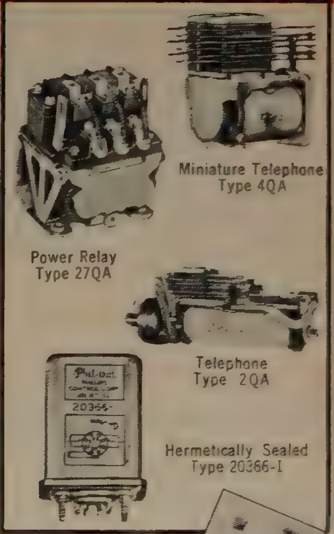
Sets a New High in Performance, Efficiency and Economy!

- WITHSTANDS VIBRATION AND SHOCK
- LONG OPERATING LIFE
- COMPACT, LIGHTWEIGHT, RUGGED
- 10 TO 20 AMPERE CAPACITY
- RESPONDS TO ½ CYCLE
- 1 TO 5 POLE, DOUBLE THROW

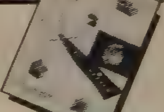


The new Phil-trol Type 33 Relay is another triumph of Phillips designing and engineering. It is an important addition to the complete line of Phil-trol Relays that enables you to select the type practically tailor-made for your particular needs.

The Type 33 Phil-trol Relay is of single coil design and box shape construction. Armature and frame construction of a type that affords fast action in both operation and release. Contacts are quickly and easily pressure adjusted by means of screws. The Type 33 is available for either a.c. or d.c. operation (33 AC or 33 QA). The constant of operate and release times has qualified this relay for many applications such as are found in timing circuits.


Miniature Telephone Type 4QA
Power Relay Type 27QA
Telephone Type 2QA
Phil-trol
20366-
Hermetically Sealed Type 20366-1

Write for detailed Data Sheet and copy of latest Phil-trol Relay Catalog



Phil-trol PRODUCTS

PHILLIPS CONTROL CORPORATION
84 W. JEFFERSON ST. • JOLIET, ILL.
OFFICES IN PRINCIPAL CITIES

COILS to exact specification for every requirement
QUALITY BUILT COILS FOR RADIO, FM, TV AND GOVERNMENT APPLICATIONS

Uniform high quality, fast delivery and low cost have made Fugle-Miller coils the choice of many leading manufacturers in the radio and electronics industry. All types are supplied including Universal, Bank Wound, Universal Progressive and solenoid coils. JAN specifications are our specialty. Call, wire or write today for prompt quotations.

ADDRESS INQUIRIES TO DEPARTMENT P-2

FUGLE-MILLER LABORATORIES
MAIN STREET, METUCHEN, NEW JERSEY
Telephone: Metuchen 6-2245

FOR FREQUENCY
Stability
IN
Mobile
EQUIPMENT . . . .

make sure your crystals are made by Standard Piezo.

For years, our Crystals have been standard as original equipment with leading manufacturers and for replacement purposes by large operators of mobile equipment.

Precise, accurate, Standard Piezo Crystals are available for *ALL* types of mobile communication equipment.

Request catalog R for complete details.

Standard Piezo
COMPANY
CARLISLE, PENNSYLVANIA

News—New Products

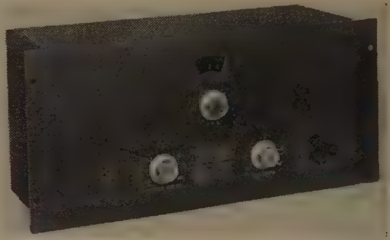
These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued on page 106A)

fayette St., New York 12, N. Y., features the use of a 5VP1 new 5 inch C-R tube. The vertical amplifier has a wide band and can be used up to 5 mc. A two step attenuator input is available. Synchronization is available on either positive or negative phase of input voltage through the vertical amplifier, or from an external source. A multivibrator type of sweep from 15 cps to 75 kc is incorporated. Direct connections to scope plate are available. Price of finished oscilloscope (Model 600) is $99.50.

Ultra-Low Frequency Oscillator

Krohn-Hite Instrument Co., 580 Massachusetts Ave., Cambridge 39, Mass., announces a new ultra-low frequency oscillator, Model 400-C, with standard rack panel construction.



This oscillator (Model 400C) simultaneously provides both sine and square-wave voltages at any frequency between 0.009 and 1,100 cps. The sine-wave output may be used either balanced or single ended. Maximum output is 30 volts peak-to-peak across a 1,000 ohm load.

Special circuitry to eliminate tuning and band-switching transients have been incorporated in this RC bridge sine-wave oscillator. Other features are low hum and distortion, excellent amplitude constancy over the entire frequency range, a single scale logarithmic dial with a vernier tuning control, and low input power.

The 400-C is useful for the designing and testing of servomechanisms, for geophysical and seismological instruments and feed-back amplifiers, for vibration checks and medical research, and in conjunction with timing and production controls. The square wave output is also useful for low frequency switching and triggering operations, and for frequency or transient response measurements. The dimensions of the unit are $19 \times 8\frac{3}{4} \times 7\frac{1}{2}$ inches and the price is $375. A descriptive pamphlet is available on request.

Frequency Calibrator

Measurement Engineering Ltd., Arnprior, Ontario, Canada, has a new portable self-contained secondary-frequency standard providing accurate frequencies in the range 10 kc to 500 mc with a stability of 1 part per million. Designed originally for military use, it is manufactured to meet joint Canadian Navy, Army, Air Force Specifications.

(Continued on page 110A)

POSITION WANTED

with a coil that has an important job to do, by a core made of G A & F Carbonyl Iron Powders. Core offers know-how born of long experience, high permeability, high Q, unusual stability and references from many major employers....

G A & F Carbonyl Iron Powders are used to produce cores for transformer and inductor coils of every form—to increase Q values, to vary coil inductances, to reduce the size of coils, to confine stray fields and to increase transformer coupling factors.

These powders are microscopic, almost perfect spheres of extremely pure iron. They are produced in seven carefully controlled types, ranging in average particle-size from three to twenty microns in diameter.

Similarly, their properties vary, making them useful in many different applications. Engineers have commented on the fact that cores made from these powders lend themselves to smoothness of adjustment and to ease of grinding. The extremely small size of the particles is of enormous value, since eddy currents develop only within each particle—proportional to the square of the particle diameter.

We urge you to ask your core maker, your coil winder, your industrial designer, how G A & F Carbonyl Iron Powders can increase the efficiency and performance of the equipment or product you make, while reducing both the cost and the weight.

Write for wholly new 32 page book—the most comprehensive treatment yet given to the characteristics and applications of G A & F Carbonyl Iron Powders. 80% of the story is told with photomicrographs, diagrams, performance charts and tables. For your copy—without obligation—kindly address Department 40.

GA&F carbonyl iron powders

G A & F® CARBONYL IRON POWDERS

MEMBER mpa METAL POWDER ASSOCIATION

ANTARA® CHEMICALS

Division of GENERAL DYESTUFF CORPORATION
435 HUDSON STREET • NEW YORK 14, NEW YORK

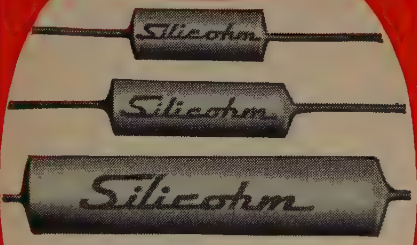
gdc ANTARA gaf

The Spotlight's On
DALOHM
Miniature
POWER RESISTORS!

WIRE WOUND—SILICONE COATED RESISTORS

Complete welded construction from terminal to terminal. Temperature coefficient 0.00002/ deg. C. Ranges from 0.1 Ohm to 55,000 Ohms, depending on Type. Tolerance 0.05%, 0.1%, 0.25%, 0.5%, 1%, 3%, 5%.

RH TYPE — Available in 25, 50 and 250 watt sizes. Silicone sealed in die-cast, black anodized radiator finned housing for maximum heat dissipation.



RS TYPE — Available in 2 watt, 5 watt, and 10 watt sizes. Silicone sealed offering maximum resistance to abrasion, high thermal conductivity and high di-electric strength.

DEPOSITED CARBON RESISTORS

Dalohm precision deposited carbon resistors offer the best in accuracy, stability, dependable performance and economy. Available in ½ watt, 1 watt and 2 watt sizes.

Carefully crafted in every respect, Dalohm resistors are true power in miniature — provide the answer to those space problems.

Write, wire or phone George Risk
1302 28th Ave., Columbus, Nebr.
for price and delivery Telephone 2139

DALE
DALE PRODUCTS, INC.
In Canada: Telotronics Corp., Ltd.
Toronto and Montreal

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 108A)

It has five fundamental frequencies with their associated harmonics; 10 kc, 100 kc, 1 mc, 5 mc, and 25 mc. The crystal controlled oscillators employ temperature stabilized crystals for 1 mc, 5 mc and 25 mc. These are adjusted to Zero beat with the U. S. Bureau of Standards station WWV. Multivibrator circuits are synchronized with the 1 mc oscillator for 10 kc and 100 kc signals. Output frequency may be modulated by an internal 400 cps signal.

An internal aperiodic detector, two-stage audio amplifier, and electron ray tube visual zero beat indicator provide a means for detection without the need for external instruments.

Electronically regulated power supply eliminates the effects of power line variations from 100 to 125 volts ac. Supplied for use with 115 volts 60 cycle power source. Shipping weight is 50 pounds. Price is $550 f.o.b. Arnprior with export packing.

C-R Tube Analyzer

A new testing instrument made by **The Jackson Electrical Instrument Co.,** 18-36 S. Patterson Blvd., Dayton 2, Ohio, is the Dynamic Cathode-Ray Tube Analyzer (Model 707). The manufacturer states that it completely and accurately tests all TV picture tubes, both magnetic and electrostatic deflected types. It will also analyze oscilloscope, radar, and other special purpose C-R tubes, without removal from chassis or carton.

Four classes of tests are made with the analyzer. The beam current test is made to the final anode rather than to the grid or any other element. The beam current

(Continued on page 111A)

FIRST WITH THE FINEST IN . . .

- CATHODE-RAY OSCILLOGRAPHY
  Instrument Division,
  1500 Main Ave., Clifton, N.J.
- CATHODE-RAY TUBES AND COMPONENTS
  Cathode-ray Tube Division,
  750 Bloomfield Ave., Clifton, N.J.
- TELEVISION TRANSMITTING EQUIPMENT
  Television Transmitter Division,
  1500 Main Ave., Clifton, N.J.

DU MONT
ALLEN B. DU MONT LABORATORIES, INC.

NEED INSTRUMENTS TO SOLVE ELECTRONIC PROBLEMS?...

RADA-SWEEP
Radar IF Amplifier Alignment
MEGA-MATCH
Measurement of Reflection Coefficient
MEGA-PULSER
Transient Testing Video Amplifiers
MARKA-SWEEP RF-P
TV Tuner Alignment
RADA-PULSER
Radar IF Transient Testing
CALIBRATED MEGA-SWEEP
Wide Range Sweeping Oscillator
Single Dial Tuned

CONSULT THIS LATEST 64-PAGE CATALOG

Write FREE

KAY ELECTRIC CO.
14 MAPLE AVE. PINE BROOK, N. J.

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 110A)

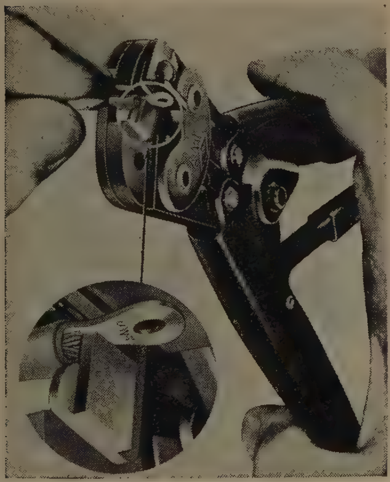
scale of the meter not only indicates sufficient or insufficient beam current, but also gives an accurate forecast of remaining tube life.

A grid test is provided to observe grid control over the beam current. This is essential, since the tube is useless if the grid does not have the ability to cut off and control the beam current.

The gas test indicates whether or not any accumulated gas is sufficient to threaten quick failure of the screen or cathode or both.

Solderless Terminal Tool

An easy and accurate means of crimping solderless terminal wires having extremely thin-walled insulation has just been announced by **Aircraft Marine Products, Inc.,** 2100 Paxton St., Harrisburg, Pa.



Deltabeston, Type SI-57360, Neolay and similar wires conforming to Specification MIL-M-5086, have extremely thin insulation sheathing which makes them ideal for aircraft wiring. However, they are difficult to terminate unless a worker exercises great care, he is apt to force both wire and insulation into the terminal barrel.

To solve this problem, a wire positioner called the Shur-Stop is incorporated in the certi-crimp hand tool. This positioner stops the stripped wire in its proper place and prevents the insulation from being inserted in the terminal barrel.

In addition to the Shur-Stop there are two other positioners which help to produce perfect terminations on the Deltabeston-type wires. A terminal guide orients the terminal correctly in the tool jaws, and the terminal barrel-stop positions the terminal at the proper crimping area.

Complete information and further details will be supplied promptly.

(Continued on page 112A)

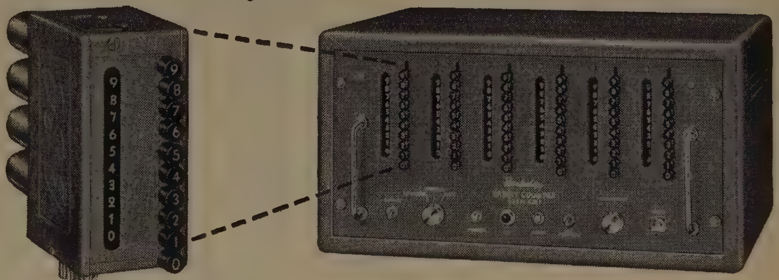
Now...

COUNTING

PLUS CONTROL

AT RATES TO 40,000 CPS WITH

Berkeley **PRESET COUNTERS**



DESCRIPTION—The Berkeley Preset Counter is an electronic decade with provisions for producing an output signal or pulse at any desired preset count within the unit's capacity. Any physical, electrical, mechanical or optical events that can be converted into changing voltages can be counted, at rates from 1 to 40,000 counts per second. Total count is displayed in direct-reading digital form. Presetting is accomplished by depressing pushbuttons corresponding to the desired digit in each column. Model 730 Preset Decimal Counting Units are used. These are completely interchangeable plug-in units designed for simplicity of maintenance and replacement.

APPLICATIONS—Flexibility and simplicity of operation make the Berkeley Preset Counter suitable for both production line and laboratory use. It has practical applications wherever signalling or control, based on occurrence of a predetermined number of events or increments of time is desired. Output signals from the unit can be used to actuate virtually any type of process control device, or to provide aural or visual signals.

SPECIFICATIONS	Model				
	422	423	424	425	426
MAX. COUNT CAPACITY	100	1000	10,000	100,000	1,000,000
INPUT SENSITIVITY (MIN.)	± 1 v. to ground, peak; at least 2 μ sec. wide				
OUTPUT	Choice of pos. pulse and relay closure, or pos. pulse. SPST relay closure approx. 1/30 sec; pulse output is + 125 v. with 3 μ sec. rise time and 15 μ sec. duration.				
PANEL DIMENSIONS	15⅜" x 8¾"		19" x 8¾"		
OVERALL DIMENSIONS	16⅝" x 10¼" x 13"		20¾" x 10½" x 15"		
POWER REQUIREMENTS	117 v. ± 10% @ 90w.		117 v. ± 10% @ 180 w.		
PRICE (F.O.B. FACTORY)	$375	$450	$595	$695	$795

M3 *For complete information, please request Bulletin 202*

Berkeley Scientific

division of BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVENUE • RICHMOND, CALIFORNIA

"DIRECT READING DIGITAL PRESENTATION OF INFORMATION"

Fine Wire FOR TRANSISTORS

In line with our specialization in wire for new applications, we produce wires of composition suitable for the manufacture of Transistors; including GALLIUM GOLD and ANTIMONY GOLD. These alloys have been made to fill a specific need arising from new developments in this field.

Other wires we make regularly for similar application are PHOSPHOR BRONZE, bare or electroplated, and PLATINUM Alloys produced to meet rigid specifications of tensile strength, size and straightness.

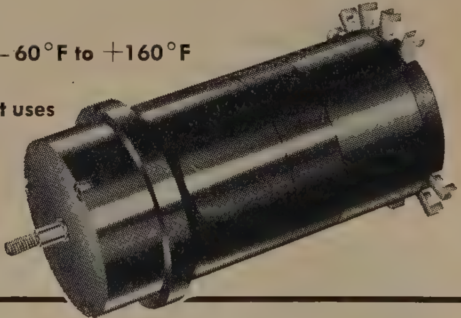
SINCE 1901

Write for Latest List of Products

SIGMUND COHN CORP.
121 SOUTH COLUMBUS AVENUE • MOUNT VERNON, NEW YORK

FORD
ELECTRICAL RESOLVERS

- interchangeability
- temperature compensation —60°F to +160°F
- highest accuracy
- adaptability to special circuit uses
- 400 cycle frequency



Now you can get the same Ford Electrical Resolvers, precision-built to the highest degree of operating efficiency for our own quality computers and automatic control equipment . . . to meet *your* extra special requirements!

FREE — fully illustrated brochure gives more details, describes Ford Instrument resolver systems. ***WRITE FOR YOUR COPY TODAY!*** Address Dept. IRE-1.

8

FORD
FORD INSTRUMENT COMPANY
DIVISION OF THE SPERRY CORPORATION
31-10 Thomson Avenue, Long Island City 1, N. Y.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 111A)

Oil-Filled Capacitors

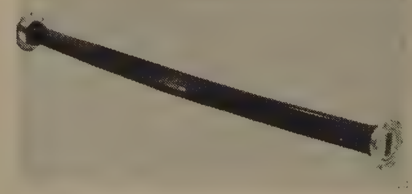
A complete line of easy-mounting single-stud tubular oil-filled capacitors is being offered by the **Industrial Condenser Corp.**, 3243 N. California Ave., Chicago 18, Ill. Addition of an 8 μf (600 vdc), dual 4 μf (600 vdc), 4 μf (1,000 vdc), and similar units of the same case size makes this one of the most extensive series now available in this class of capacitors.

Known as the G and H types, complete data on these capacitors is available in a new 4-page illustrated catalog. Capacitors are oil-impregnated and filled with Indco Oil "A". Pyroteen filled capacitors also available. Standard capacity tolerance: +20 per cent −10 per cent. Temperature range: (Indco Oil), −40° to +70° C.; (Pyroteen), −70° to +90° C. Power factor: (Indco Oil), 0.4 per cent; (Pyroteen), 0.2 per cent.

The moulded-mounting neck is locked in the capacitor case so that capacitors will meet salt water immersion requirements. They are supplied with solid nuts and lock washers for mounting. Unless otherwise specified, capacitor case is insulated from terminals. For catalog and further information write to the company.

Flexible Waveguides

"Waveflex" flexible waveguides, manufactured by **Titeflex, Inc.**, 500 Frelinghuysen Ave., Newark, N. J., presently undergoing extensive in-field testing by the Air Force for inclusion in the world-wide U. S. Air Force microwave communications system. They are being installed wherever shock mounting or movement are present in equipment.



The flexibility of Waveflex permits bends, twists and small radii bends with practically no change in electrical properties. If necessary, a Waveflex assembly can be bent in the E plane around an arbor having a diameter as small as two times

(Continued on page 115A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 112A)

the major axis of the waveguide, and in the H plane around an arbor having a diameter as small as three times the major axis of the waveguide. Waveflex assemblies have been flexed over a million cycles and have retained their physical and electrical properties.

Voltage standing wave ratios are well below JAN-W-287 specification requirements, and are maintained through bends up to 180°.

Waveflex waveguides are designed to meet JAN requirements of every application before shipment.

Vertical Deflection Amplifier

The General Electric, Tube Dept., Schenectady 5, N. Y., announced that a new high-perveance triode for vertical output service in television receivers has been added to its receiving tube line.

The tube, type 6AH4-GT, a vertical deflection amplifier, is expected to be particularly useful in receivers with large-deflection-angle picture tubes.

The tube utilizes relatively low-plate voltages at high-plate currents to fully deflect wide-angle picture tubes. It is capable of withstanding the high pulse voltages normally encountered in this application.

Typical operating characteristics with 250 volts on the plate include: heater voltage 6.3 volts; grid voltage, −33 volts; plate current, 30 ma transconductance, 4,500 micromhos; amplification factor, 8.0; and plate resistance, 1,780 ohms.

High Power Audio Amplifier

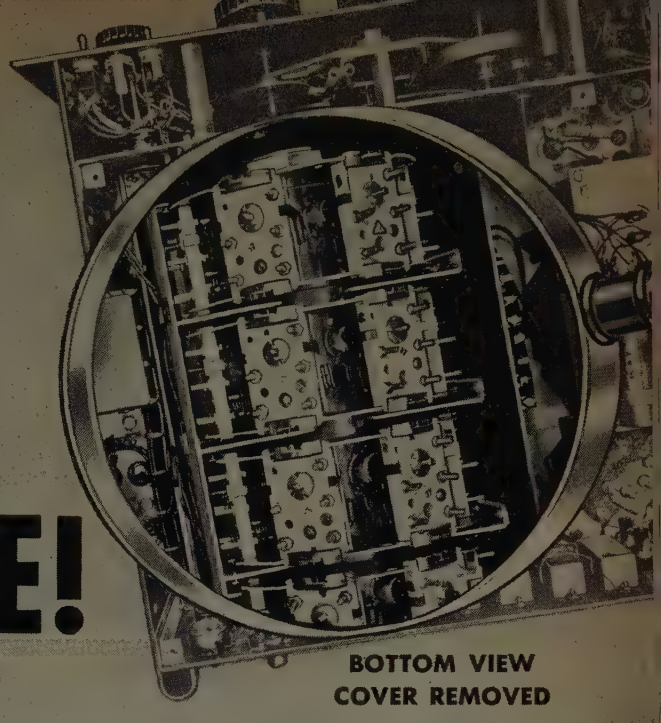
A new variable-frequency audio amplifier (type FG 5/10) capable of delivering either 5 or 10 kw output power is available from the **Westinghouse Electric Corp.,** P.O. Box 2099, Pittsburgh 30, Pa.

This power amplifier will take a signal of about 10 milliwatts from any conventional 30 to 10,000 cps source and build it up to 5 or 10 kw with uniform response (±1.5 db).

The type FG audio amplifier is useful in laboratories where a variable frequency power supply is required or in conjunction with high power pulsing equipment, and also in many industrial processes.

(Continued on page 116A)

LOOK at any part UP CLOSE!



BOTTOM VIEW
COVER REMOVED

THE SP-600-JX
Communications Receiver
USES ROTARY TURRET FOR
MAXIMUM SENSITIVITY!

A rotary turret, uniquely incorporated into the "Super-Pro 600-JX," makes possible the placement of the coil assemblies of the two RF Amplifier stages, Mixer stage and First Heterodyne Oscillator stage directly adjacent to their respective sections of the four-gang tuning capacitor and the individual tubes.

Coil assemblies are mounted on the turret. Turning the band selector switch to any one of the six frequency bands places the required coils immediately in their correct positions. This arrangement increases receiver stability, provides uniform maximum performance from band to band, and simplifies servicing.

Every part of the "SP-600-JX" is designed to the highest standards of receiver design. The rotary turret is one example of the fine engineering in this magnificent 20-tube receiver.

The "SP-600-JX", the only professional communications receiver available that provides up to six crystal controlled frequencies, has a range of 540 kc. to 54 mc. It is now being used by the U. S. Army, Navy, and Air Force, other governmental agencies, airlines, the press, maritime, and commercial services, for both single channel and diversity reception. Write today for further details.

HAMMARLUND
42 YEARS EXPERIENCE COUNTS!
HAMMARLUND MANUFACTURING CO., INC.

MODEL 503
Fast-Rise
Pulse Generator

The -SKL- Model 503 Fast-Rise Pulse Generator has been designed to meet the growing need for a convenient source of extremely fast and short rectangular pulses. In radar, nuclear physics, high speed oscillography, and in the determination of network characteristics, the fast rise time and short pulse capabilities of the Model 503 find many uses. The variable repetition rate of 50 to 150 pps, pulse amplitude of .1 to 150 volts, and impedance of 50 ohms meet the great majority of needs encountered in this type of work. Convenience in the practical situation is enhanced by providing either positive or negative pulses, controlled by a switch, and an external trigger input which allows control of the repetition rate from an outside source. It is housed in a lightweight aluminum cabinet with convenient grouping of controls. The -SKL- Model 503 will be found indispensable for high speed, fast rise time research, development and testing.

SPECIFICATIONS:

- Rise Time: 10^{-9} sec. (1 millimicrosecond)
- Impedance: 50 ohms
- Rep Rate: 50 to 150 pps.
- Pulse Amplitude: 0.1 to 150 volts
- Pulse Width: Calculated minimum width is 6×10^{-10} sec.

SKL SPENCER·KENNEDY LABORATORIES, INC.
186 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

made right to work right
BENDIX-FRIEZ
high-precision thermistors

Whether you use these temperature responsive resistors in standard or special models, you can be sure of this. *They'll match your needs* for resistance values, size, temperature coefficient, mountings and quality. Made in our own plant under carefully controlled conditions, Bendix-Friez Thermistors know no equal.

STANDARD TYPES FOR IMMEDIATE DELIVERY

Size (inches)	@ +30°C.	@ 0°C.	@ −30°C.
.140 x .75	45.0 ohms	86 ohms	194 ohms
.040 x 1.5	12,250 ohms	26,200 ohms	65,340 ohms
.018 x 1.5	35,000 ohms	82,290 ohms	229,600 ohms

Write for details.

FRIEZ INSTRUMENT DIVISION of . .
1490 Taylor Avenue, BALTIMORE 4, MARYLAND
Export Sales: Bendix International Division
72 Fifth Avenue, New York 11, N. Y.

Used in this typical application for sensing the temperature of hydraulic oil.

Bendix
AVIATION CORPORATION

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 115A)

Field Strength Meter

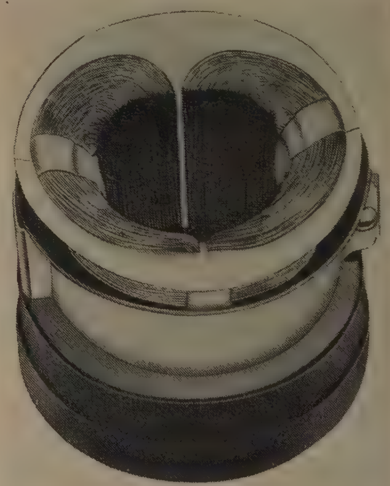
A new uhf-vhf field strength meter has just been introduced by **Erwood, Inc.,** 1770 Berteau St., Chicago 13, Ill.

This meter was designed to determine the strength of signals available at any given location and covers all the frequencies used today in broadcasting television and FM programs. It is also useful in determining the relative efficiency of different types of antennas as well as the optimum height.

The vhf range is continuous from 52 to 218 mc, with sensitivity at 60 per cent meter deflection per 100 mv input. The uhf range is continuous from 470 to 890 mc, with sensitivity at 50 per cent meter deflection per 100 mv input. Number of tubes used, 11. Power consumption 70 watts, 110 v ac.

Deflection Yokes and Flybacks

An entirely new line of cosine deflection yokes and flybacks, announced by **Todd-Tran Corp.,** Mt. Vernon, N. Y., are said to embody advanced design elements not previously employed. These new components will be identified as "Green Band" products.



Todd has been successful in developing highly effecient 90° deflection systems for 27- and 30-inch tubes. These are already enjoying acceptance among several of the leading TV receiver manufacturers. Todd also produces a line of deflection yokes for special applications. These include direct drive, high impedance, and four and eight phase radar types.

Green Band Yokes employ rigid nylon segments for inter-coil insulation. This also achieves high orders of cross-talk ratios. Among the special properties claimed for these yokes are high deflection sensitivity, good line and corner focus, high-Q geometry, coil balance to within one turn, compensated cosine design minimizing pincushion effect, and minimum leakage flux. All cosine yokes have ferrite cores.

(Continued on page 117A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 116A)

Miniature Oval Resistors

New oval-type wire wound resistors, designed to give higher wattage ratings within small space limitations are being manufactured by the **Milwaukee Resistor Co.**, 700 W. Virginia St., Milwaukee 4, Wis.

These small resistors are equipped with an aluminum mounting strip to provide cooler operating temperatures and greater dissipation of heat caused by contact with the ceramic core.

Spacers attached to the ends of the

(Continued on page 118A)

MODEL A-4
TIME DELAY GENERATOR

- A precision device for the generation of accurate and variable time intervals from .00001 to 10 seconds.

Also available:
Model A-2—.8 to 100,000 µs.

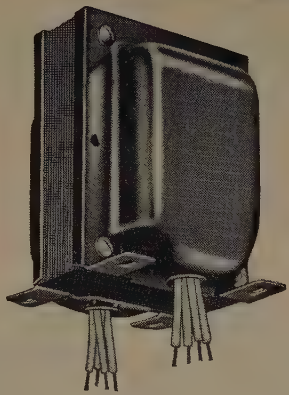
Write for complete data:
Our bulletins I-A-4 and I-A-2

Rutherford ELECTRONICS CO.
3707 S. ROBERTSON BLVD., CULVER CITY, CALIF.

these **TWO STANCOR TRANSFORMERS**

are part of Stancor's extensive line of catalog part numbers,

available for immediate delivery from your local electronic parts distributor



CATHODE RAY TUBE POWER TRANSFORMER, P-8151, for use with type 2X2 rectifier tubes in a conventional half-wave high voltage supply. Plate supply 2,400 AC volts, half wave, 5.0 DCMA. Rectifier filament 2.5 volts at 2.0 amps. Other windings, 2.5 volts at 2.0 amps. Height 4⁵⁄₁₆", base area 3⁹⁄₁₆" x 3⅞".

HIGH-FIDELITY INPUT TRANSFORMER, WF-20, for low impedance microphone, pickup or line to grid. Primary impedance 50, 125/150, 200, 250, 333, 500/600 ohms. Secondary impedance 50,000 ohms. Frequency response 30-20,000 cps, ± 2 db. Negligible harmonic and intermodulation distortion. Grey enamel cast case with phenolic terminal board and tapped holes for flush mounting. 2" high by 1½" square.

These units are examples of the many specialized transformers in the Stancor cataloged line . . . units that are regularly carried in stock.

Check the Stancor Catalog first when you need transformers for industrial, amateur, audio, radio, TV or any other electronic application. You're almost sure to find it there.

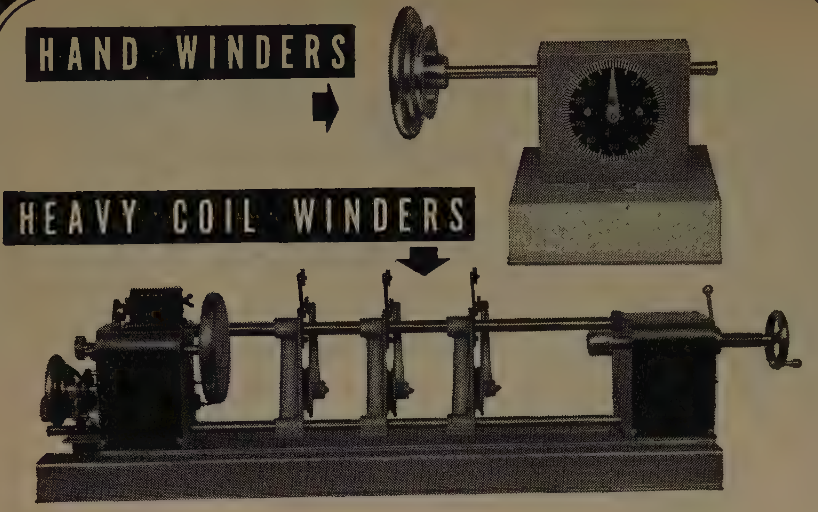
You can get your FREE copy from your Stancor distributor, or by writing Stancor direct.

STANDARD TRANSFORMER CORPORATION is one of the leading suppliers of industrial and military transformers built to the manufacturers specifications.

Stancor is your best source for hard-to-design, tough-to-build transformers. At Stancor you will have the services of experienced design engineers and a fully equipped test laboratory with complete facilities for in-plant testing of MIL-T-27 components. Your transformers will be built in the industry's newest transformer plant, using the most modern production and test equipment.

STANCOR

STANDARD TRANSFORMER CORPORATION
3582 Elston Avenue, Chicago 18, Illinois

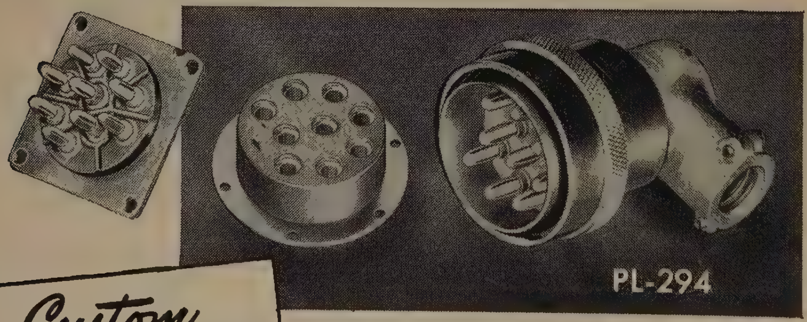


We have them all!

We have machines for Laboratory, Moderate or Maximum Production. See the new developments in Coil Winding at the IRE Show, March 23-26 in Booth 3-521.

Coil Winding Equipment Co.
109 AUDREY AVE., OYSTER BAY, NEW YORK

Try Remler for Service-Tested "Hard-to-Get" Components



Custom Components

Metal-plastic components designed and manufactured to order. Write for quotations specifying electrical and mechanical characteristics. Describe application. No obligation.

PLUGS & CONNECTORS
BANANA PIN TYPES...JAN SPECIFICATIONS

Multi-contact connectors and mating chassis counterparts. Melamine or alkyd insulation; steel or brass nickel-plated shells. Banana springs are heat treated beryllium copper. Unexcelled low resistance contact. Highest quality . . . good for thousands of connects and disconnects.

Special Connectors to Order—Miniatures; water tight and pressure proof types to JAN specifications.

Remler Company Ltd. 2101 Bryant St. San Francisco 10, Calif.

Remler
Since 1918 **PIONEERS IN ELECTRONICS AND PLASTICS**

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 117A)

aluminum strip permit easy stack mounting and better heat conduction to the mounting surface. The resistors are available in 10 watts ($\frac{3}{8}\times\frac{3}{4}$ inch) and 15 watts ($\frac{3}{8}\times1$ inch) sizes.

The resistors are wound on oval steatite cores with silver soldered connections and coated with a high grade brown vitreous enamel. Samples on request. For additional information, write, wire or phone Milwaukee Resistor Co.

Recent Catalogs

Tech Laboratories, Inc., 6 E. Edsall St., Palisades Park, N. J., has released a 38 page catalog describing their complete line of precision electrical resistance instruments and electronic devices.

Meter

The Phaostron Co., 151 Pasadena Ave., South Pasadena, Calif., is now in production on a new laboratory instrument, ruggedized for field service and available as a dc voltmeter, ac voltmeter and dc milliammeter.

Among the instruments featured are five full-scale ranges, a range-and-scale changer which automatically alters meter electrical characteristics to correspond to the selected scale, a visible selected scale to eliminate reading errors of multi-scale instruments, a mirror scale for laboratory precision, 3-way binding posts, and a military-type, ruggedized movement.

These instruments are available singly and in sets of four, and make possible simultaneous measurement of two or more circuit characteristics.

Illustrated literature and complete information are available upon request to Phaostron.

Linear Motion Potentiometer

Bourns Laboratories, 6135 Magnolia Ave., Riverside, Calif., has developed a

(Continued on page 120A)

A NEW HIGH

IN AUDIO WAVE FORM ANALYSIS

PANORAMIC SONIC ANALYZER LP-1

Specifically designed for applications demanding maximum resolution, the LP-1 offers many new possibilities in high speed analysis of sounds, vibrations and electrical wave forms.

4 SELECTABLE SCANNING RANGES

Log Scan 40 cps to 20,000 cps

3 Linear Scanning Ranges	Resolution
100 cps	26 cps
500 cps	53 cps
1500 cps	105 cps

• Graphic presentation of frequency vs voltage • Selection and magnification of any spectrum segment for sharp, detailed analysis • Automatic maximum resolution on all scanning ranges • Continuously variable tuning control from 40 cps to 20 KC • One cycle per second scanning rate • Wide input voltage range of 500 M.V. to 500 V • Sweep oscillator output connection for operation with Panoramic Sonic Response Indicator G-2

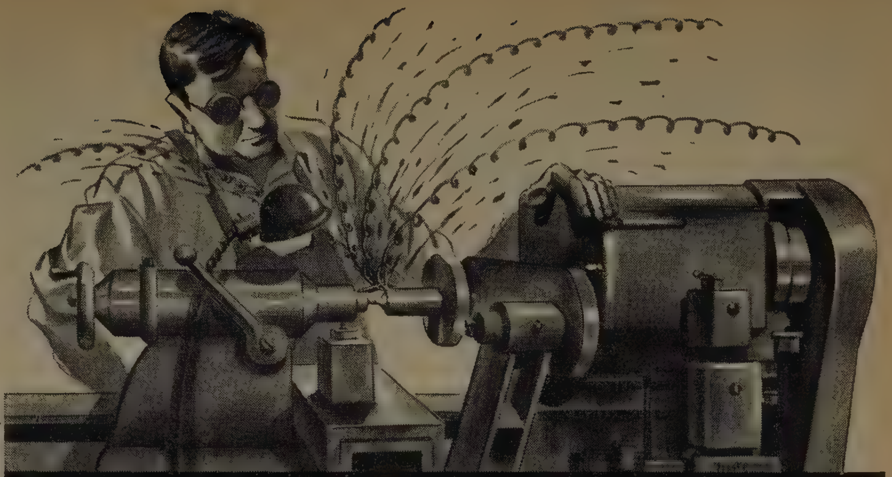
SPECIAL APPLICATIONS

• Investigations of closely spaced sound and vibration frequencies • Harmonic analysis of waveforms having low frequency fundamentals • Spectrum analysis requiring constant band width

Write today for complete specifications.

PANORAMIC
RADIO PRODUCTS, INC.

12 South Second Ave., Mount Vernon, N. Y.
Phone: MOunt Vernon 4-3970



SECONDARY OPERATIONS NIL!

Manpower . . . machinery . . . technical skill—these are the wastes of many companies adapting inflexible standard components to meet the requirements of their applications.

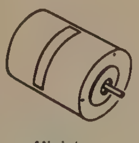
Sometimes they buy standard components and struggle to build systems around them, thus limiting the efficiency of their own designs. But more often they perform one or more secondary operations on the component to make it usable. The result is not only waste but loss of the component's "built-in" precision.

When you buy Transicoil components for servo systems, secondary operations are nil. You get a finished product . . . built for your particular application . . . and ready for immediate installation . . . with all the accuracy and efficiency for which it was designed.

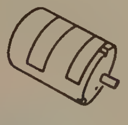
Our technical catalog describes some of the precision Transicoil units which enable you to take full advantage of your servo system designs. Write for a copy today.

TRANSICOIL
CORPORATION

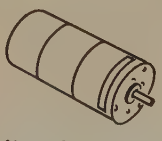
107 GRAND STREET
NEW YORK 13, N.Y.



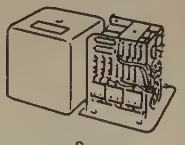
Miniature Control Motors



Motor and Gear Train Assemblies



Motor, Generator, and Gear Train Combinations



Servo Amplifiers

TELEMETER RECEIVING SET
—32 CHANNELS

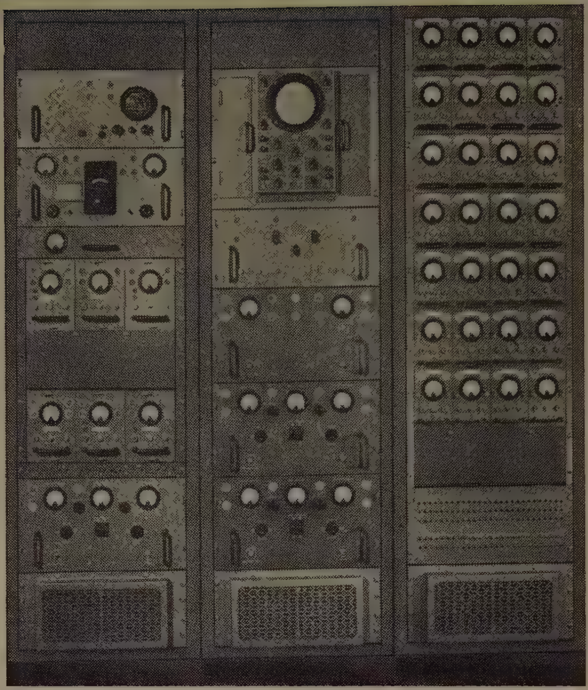
Carrier frequency:
FM, 215-235 MC/S

Subcarriers: 6
5, FM continuous information
1, FM commutated information, 27 sub-channels

- Automatic Data Separation
- All Electronic
- High Degree of Accuracy and Reliability

For precision equipment in the fields of

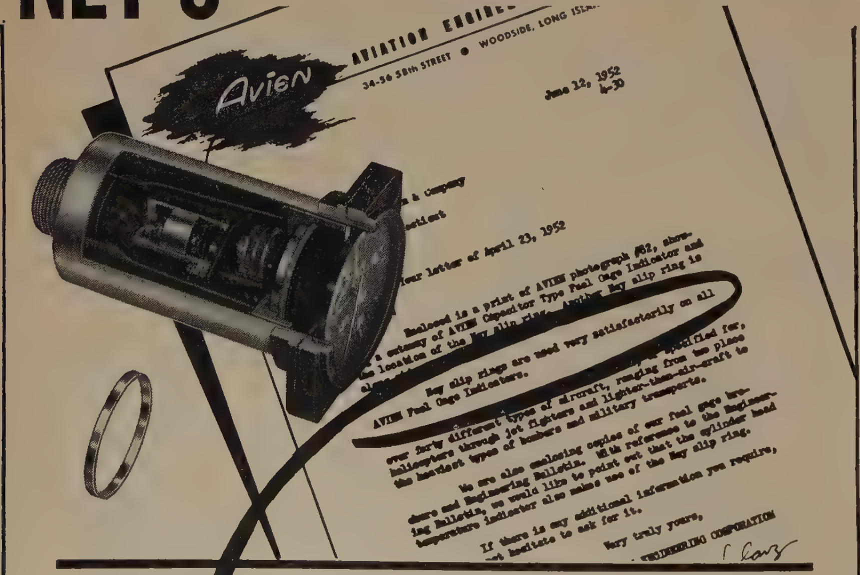
RADIO CONTROL
& TELEMETERING



RREP

RAYMOND ROSEN ENGINEERING PRODUCTS, Inc.
32nd & Walnut Streets • Philadelphia 4, Pa.

NEY'S SMALL PARTS PLAY A BIG PART IN PRECISION INSTRUMENTS



AVIATION ENGINE...
34-36 58th STREET • WOODSIDE, LONG ISLA...

June 12, 1952
h-30

... & Company
...cticut

...our letter of April 23, 1952

Enclosed is a print of AVIEN photograph #82, showing a cutaway of AVIEN Capacitor Type Fuel Gage Indicator and the location of the Ney slip ring. ... Ney slip ring is ...

Ney slip rings are used very satisfactorily on all AVIEN Fuel Gage Indicators. ... specified for, over forty different types of aircraft, ranging from the plane helicopters through jet fighters and lighter-than-air-craft to the heaviest types of bombers and military transports.

We are also enclosing copies of our fuel gage brochure and Engineering Bulletin. With reference to the Engineering Bulletin, we would like to point out that the cylinder head temperature indicator also makes use of the Ney slip ring.

If there is any additional information you require, ...t hesitate to ask for it.

Very truly yours,
...ENGINEERING CORPORATION

NEY slip rings are used very satisfactorily on all AVIEN Fuel Gage Indicators.

Do you have our Bulletins R-12, R-13, and R-14?

THE J. M. NEY COMPANY, 171 Elm St., Hartford 1, Conn.
Specialists in Precious Metal Metallurgy Since 1812

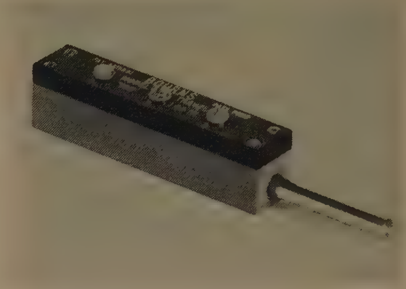
19HY82A

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 118A)

linear motion potentiometer with precision wire-wound resistance elements for airborne and industrial electronic systems. This instrument is used to convert mechanical movement or position into an electrical signal which can be transmitted to remote recording and indicating devices. It is suitable where a combination of miniaturization, ruggedness, and reliability is essential.



Linearity, tested by the continuous calibration method, is ±0.5 per cent or better. A resolution of 0.001 inch is attainable with standard shaft travels of $1\frac{5}{16}$ (model illustrated), $2\frac{1}{4}$, 4 and 6 inches. Intermediate travels are also available. This potentiometer will withstand sustained acceleration of 100 G's and vibration of more than 1,000 cps.

Standard resistances range from 1,000 to 50,000 ohms. An output of at least 26 volts is attainable from this potentiometer. Such a high output can normally be used without further amplification in aircraft and guided missile control systems, telemetering networks and recording circuits.

Coil Bobbin Kit

Potter & Brumfield, Plastics Div., Princeton, Ind., has recently announced a coil bobbin kit, No. 75A047, consisting of 24 assorted bakelite coil bobbins. The kit contains three bobbins each of eight different types. The bobbin kits, listing at $1.50 each, are now available at electronic parts distributors. Project engineers, who wind their own coils to meet specific circuit requirements, will find the kit especially use-

(Continued on page 121A)

News—New Products

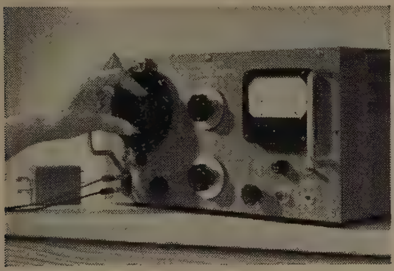
These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 120A)

ful, since all sizes are available from the manufacturer in production quantities. In addition, the bobbins can be used for rewinding coils for various relays, especially those manufactured by Potter & Brumfield. Bobbins are one-piece molded general-purpose bakelite and withstand 85°C rise, and more than 1,000 volts ac.

Wave Analyzer

A new wave analyzer (Model 121) developed by **Sierra Electronic Corp.**, 811 Brittan Ave., San Carlos, Calif. has been created for the analysis of the frequencies and amplitudes of signal components in a complex waveform. A novel two-attenuator design permits a wide range of measuring amplitudes without the introduction of instrument distortion.



Signal components are read directly on a 4-inch indicating instrument calibrated in decibels. Voltage calibration is accomplished with an internal 100-kc injection oscillator, and a listening jack is provided for monitoring the signal being measured.

The instrument has an input level range from +42 dbm to −70 dbm at a 600-ohm impedance level. Input impedance is 10,000 ohms in the pass band.

Selectivity is such that 100 cps off resonance the response is 3 db down; 200 cps off resonance, 10 db down; 500 cps, 30 db; and 1,000 cps, 45 db. Measuring accuracy is ±2 db and spurious components are at least 50 db below signal fundamental.

30 KV DC Supply

Neutronic Associates, 83-56 Vietor Ave., Elmhurst 73, N. Y., announce the availability of their new rf dc power supply, 1 kv to 30 kv, with a regulated, reversible 5 ma rating. Output is from below 1 kv to 30 kv at 5 ma in three ranges. (Up to 400 watts of regulated ac may be drawn simultaneously from outlets on front panel). Regulation is 0.1 per cent at all voltages. Line voltage stabilization is 0.1 per cent from 105 to 130 v ac. Ripple voltage is less than 0.05 per cent of dc output voltage. Output polarity is reversible, either positive or negative. The output kilovoltmeter, has three ranges, 0–5, 0–15 and 0–30 kv. Current meter has three

(Continued on page 122A)

SENSITIVITY—ACCURACY—STABILITY

make **BALLANTINE**

The World's Leading Electronic Voltmeters

AUDIO TO 150 KC **Model 300**

1 mv—100 v	Voltage Range
10 cps—150 kc	Frequency Range
2% ENTIRE RANGE	Accuracy
½ meg. shunted by 30 μμf	Input Impedance

SUB-AUDIO TO 150 KC [Battery Operated] **Model 302B**

100 μv—100 v	Voltage Range
2 cps—150 kc	Frequency Range
3% 5 cps—100 kc 5% 2 cps—5 cps 100 kc—150 kc	Accuracy
2 meg. shunted by 15 μμf*	Input Impedance

AUDIO TO 2 MC **Model 310A**

100 μv—100 v	Voltage Range
10 cps—2 mc	Frequency Range
3% to 1 mc 5% 1 mc—2 mc	Accuracy
2 meg. shunted by 15 μμf*	Input Impedance

AUDIO TO 6 MC **Model 314**

1 mv—1000 v (100 uv—1 mv without probe)	Voltage Range
15 cps—6 mc	Frequency Range
3% to 3 mc 5% 3 mc—6 mc	Accuracy
11 meg. shunted by 6 μμf (1 meg. shunted by 25 μμf without probe)	Input Impedance

PEAK-TO-PEAK **Model 305**

1 mv—1000 v pk-to-pk	Voltage Range
10 cps—100 kc (Sine Wave)	Frequency Range
3 μsec—250 μsec	Pulse Width
20 pulses per sec.	Min. Rep. Rate
5% for pulses	Accuracy
2 meg. shunted by 15 μμf*	Input Impedance

*Shunt capacitance is 8 μμf on all ranges except two most sensitive ranges.

Write for complete catalog of all Ballantine Electronic Instruments

BALLANTINE LABORATORIES, INC.

102 Fanny Road, Boonton, N.J.

FREE 236-PAGE

ALLIED 1953

ELECTRONIC SUPPLY CATALOG

ONE COMPLETE DEPENDABLE SOURCE FOR EVERYTHING IN ELECTRONICS

World's Largest Stocks of Electronic Supplies for Industry and Broadcast Stations

Simplify and speed your purchasing of electronic supplies and equipment—send *all* your orders to ALLIED—the reliable one-supply-source for *all* your electronic needs. Depend on ALLIED for the world's largest stocks of special-purpose electron tubes, test instruments, audio equipment, electronic parts (transformers, capacitors, controls, etc.) and accessories—complete lines of quality apparatus. Our expert Industrial supply service saves you time, effort and money. Send today for your FREE copy of the 1953 ALLIED Catalog—the *complete, up-to-date* guide to the world's largest stocks of Electronic Supplies for Industrial and Broadcast use.

We specialize in Electronic Equipment for Research, Development, Maintenance and Production Operation

SEND FOR FREE 1953 CATALOG

ALLIED RADIO CORP.

833 W. Jackson Blvd.,
Dept. 35-B-3
Chicago 7, Illinois

TRULY "MICROMINIATURIZED"

- TRANSISTOR PRODUCTS' GOLD BONDED GERMANIUM DIODES

These extremely small plastic-encased germanium diodes offer a great many advantages for a multitude of applications. Excellent for low level use, they also have unusually high conductivity at high levels. The gold bonding technique produces a permanent weld to the germanium surface. Noise characteristics are excellent, and high frequency rectification characteristics are vastly superior to conventional types.

TINNED WIRE LEAD
Actual Size
PLASTIC
TINNED COPPER RIBBON

- TRANSISTOR PRODUCTS' GERMANIUM TRANSISTORS

Designed to perform many of the functions of vacuum tubes as well as opening frontiers for new apparatus in the field of electronics, TRANSISTOR PRODUCTS point contact transistors may be used for power amplifiers, oscillators, and switches. Junction transistors and phototransistors are available as well. All have been adjudged by experts in the field to be superior; the finest performers that can be had.

Actual Size

- TRANSISTOR PRODUCTS' TRANSISTOR TEST SET

This device is designed to test the signal behavior of all transistors, and can be used most advantageously by circuit engineers and transistor manufacturers. Comparable to a vacuum tube bridge in that field, it is not, however, a null instrument. Its design insures continued usefulness as new transistors are developed.

Write to TRANSISTOR PRODUCTS now for additional information.

TRANSISTOR PRODUCTS, inc.
Snow and Union Sts., (Brighton Sta.) Boston 35, Mass.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

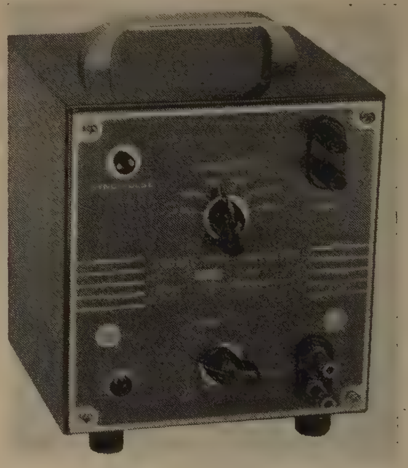
(Continued from page 121A)

ranges, 0–0.5, 0–1 and 0–5 ma. Final stage plate voltage. Final stage plate current.

Safety features are the adjustable load cut-out, and double push-buttons requiring both hands to turn on high voltage. There is a safety interlock on the rear door. Latching circuit keeps high voltage off after line voltage failure.

Square Wave Generator

The New London Instrument Co., P.O. Box 189; New London, Conn., announces their new Square Wave Generator (Type 150A), a versatile, low-cost laboratory instrument.



This compact instrument provides square waves at frequencies from 50 cps to 1 mc with a maximum rise-time of 0.05 microseconds on all frequencies. Fixed frequencies are 50, 1,000, 10,000, 100,000 and 1,000,000 cps. Other frequencies are obtainable through the use of an external frequency-control capacitor for which terminals are provided. A pulse for oscilloscope synchronization is available. Output is controllable from 0–20 volts peak to peak, and is constant at all frequency settings. Tilt and overshoot are negligible. The price is $79.50 f.o.b., New London.

(Continued on page 124A)

Accurate • Portable • AVAILABLE

the Type H-12 UHF SIGNAL GENERATOR

900-2100 Megacycles

This compact, self-contained unit, weighing only 43 lbs., provides an accurate source of CW or pulse amplitude-modulated RF. A well-established design, the Type 12 has been in production since 1948. The power level is 0 to —120 dbm, continuously adjustable by a directly calibrated control accurate to ± 2 dbm. The frequency range is controlled by a single dial directly calibrated to ± 1%. Pulse modulation is provided by a self-contained pulse generator with controls for width, delay, and rate; or by synchronization with an external sine wave or pulse generator; or by direct amplification of externally supplied pulses.

Gold Plating of the oscillator cavity and tuning plunger assures smooth action and reliable performance over long periods. Generous use of silicone-treated ceramic insulation, including resistor and capacitor terminal boards, and the use of sealed capacitors, transformers, and chokes, insures operation under conditions of high humidity for long periods.

Built to Navy specifications for research and production testing, the unit is equal to military TS-419/U. It is in production and available for delivery.

Price: $1,950 net, f.o.b. Boonton, N. J.

Type H-14 Signal Generator

(108 to 132 megacycles) for testing OMNI receivers on bench or ramp. Checks on: 24 OMNI courses, left-center-right on 90/150 cps localizer, left-center-right on phase localizer, Omni course sensitivity, operation of TO-FROM meter, operation of flag alarms.

Price: $942.00 net, f.o.b. Boonton, N. J.

WRITE TODAY for descriptive literature on A.R.C. Signal Generators or airborne LF and VHF communication and navigation equipments, CAA Type Certificated for transport or private use. Dept. 6

ARC

**Dependable
Electronic Equipment
Since 1928**

Aircraft Radio Corporation
Boonton, New Jersey

Meet the Redheads...
tops for tape recording

See how the latest additions to the Brush family of magnetic recording components can improve your tape recorders!

The BK-1090 record-reproduce head has the standard track width designed for dual track recording on ¼ inch tape. It provides unusually high resolution and uniformity over an extended frequency range. Cast resin construction assures dimensional stability, minimizes moisture absorption, and affords freedom from microphonics. Its balanced magnetic construction, precision lapped gap, Mu-metal housing, and single-hole mounting provide important design advantages.

The BK-1110 erase head has the same basic construction as the companion record-reproduce unit. Its outstanding feature is its efficient erasing at low power consumption—less than ½ voltampere.

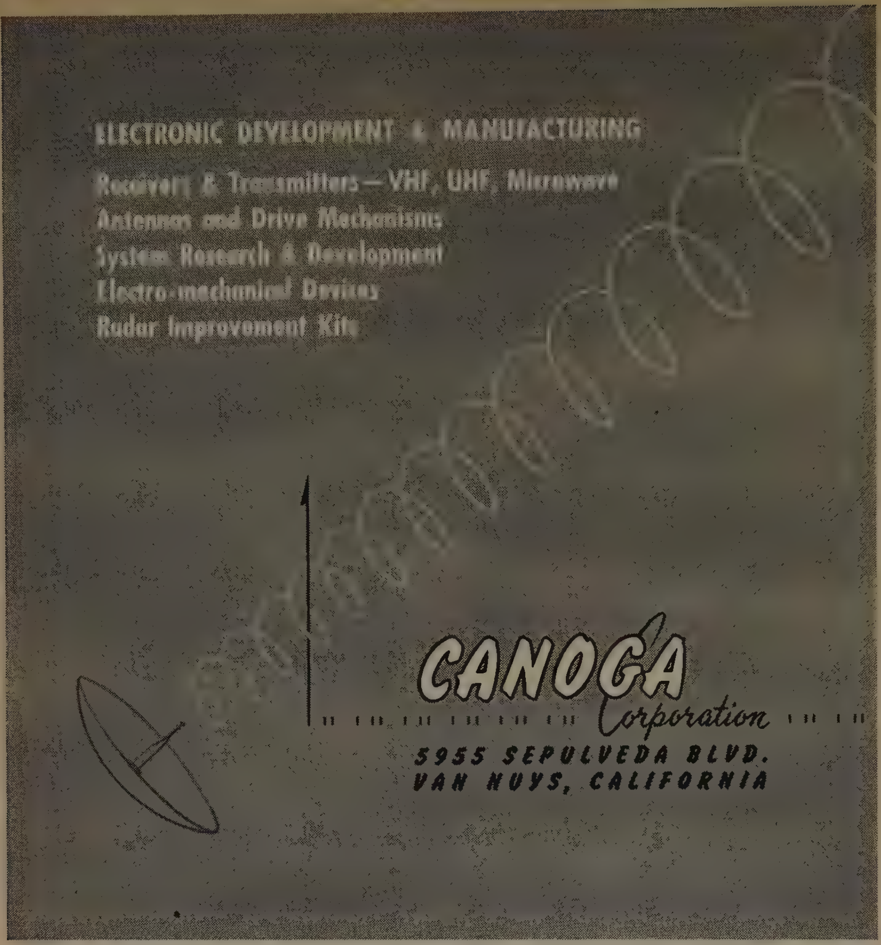
Investigate these new "Redheads" for your magnetic recording. Your inquiries will receive the attention of capable engineers. Write Brush Electronics Company, Department F-2, 3405 Perkins Avenue, Cleveland 14, Ohio.

BRUSH ELECTRONICS COMPANY

INDUSTRIAL AND RESEARCH INSTRUMENTS
PIEZOELECTRIC MATERIALS • ACOUSTIC DEVICES
MAGNETIC RECORDING EQUIPMENT
ULTRASONIC EQUIPMENT

BRUSH
ELECTRONICS

*formerly
The Brush Development Co.
Brush Electronics Company
is an operating unit of
Clevite Corporation.*



ELECTRONIC DEVELOPMENT & MANUFACTURING

Receivers & Transmitters—VHF, UHF, Microwave
Antennas and Drive Mechanisms
System Research & Development
Electro-mechanical Devices
Radar Improvement Kits

CANOGA Corporation
5955 SEPULVEDA BLVD.
VAN NUYS, CALIFORNIA

New UHF SWEEP GENERATOR for UHF TV Production Testing

TYPE 1211

The Type 1211 UHF Sweep Generator has been specifically designed to rapidly and accurately align UHF Television heads, converters and complete receivers,

SPECIFICATIONS

FREQUENCY COVERAGE: 450 to 900 MC. Dial calibrated in 36 MC steps. **BANDWIDTH:** Constant bandwidth of 50 MC over entire spectrum. Can be adjusted to narrower bandwiths, with internal controls. **MARKERS:** Pulse type crystal controlled accurate to 0.02% spaced 36 MC throughout the 450 to 900 MC spectrum. **OUTPUT:** At least 1 volt across a 75 ohm load. **ATTENUATOR:** Electrostatically coupled piston type, range approximately 80 db. **AUXILIARY OUTPUT SIGNALS:** 1. Automatically phased sine sweep for X axis of scope. 2. Marker pulses either plus or minus polarity, continuously variable in amplitude.

PRICE $950.00 F.O.B. PLANT

Manufacturers of a Complete Line of TV Test Equipment
TIC Tel-Instrument Co. Inc.
50 PATERSON AVENUE • EAST RUTHERFORD, N. J.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 122A)

Sensing Switch

Thompson Products, Inc., Electronics Div., 2196 Clarkwood Rd., Cleveland 3, Ohio, has developed an air-borne Sensing Switch actuated by a 115-volt ac, 380 to 1,000 cps motor. It has two independent double-throw rf circuits which are switched at a rapid rate (15 to 35 cps) to furnish accurate circuit time sharing. The connectors are Type "BNC" and are for use with RG-58/U cable applications. In the frequency range to 250 mc it has a maximum vswr of 2.0 to 1. Insertion loss is less than 1.0 maximum and crosstalk is in excess of 32 db. Its life is greater than 500 hours (continuous operation). Technical information available on request.

Decade Inductors

New decade inductors are now available with inductance values guaranteed to within 1 per cent by **Lenkurt Electric Co.,** 1129 County Rd., San Carlos, Calif. Four individual units cover the ranges from 1 to 10 mH, 10 to 100 mH, 100 mH to 1 H, and 1 to 10 H. All four units are also available as a single unit to cover the complete range from 1 mH to 10 H. Special ranges are available on request.

(Continued on page 126A)

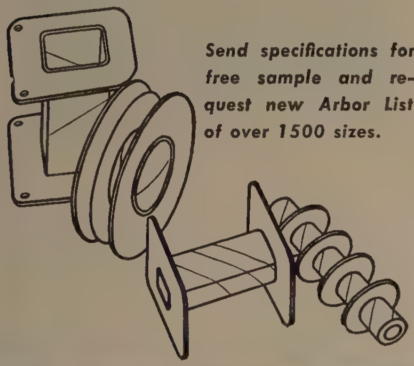
7 REASONS WHY Precision COIL BOBBINS

improve your coils . . .

- Quality Controlled
- Greater Insulation
- Better Heat Dissipation
- Higher Moisture Resistance
- 15 to 20% Stronger
- Lighter Weight
- More Winding Space

PRECISION Coil Bobbins are finished to your exact specifications. Only the finest dielectric materials are used.

Cores furnished in an infinite variety of sizes and shapes—kraft, fish paper, acetate, or combinations. Flanges cut to specifications—plain or fitted with leads, slots or holes; embossed or recessed.

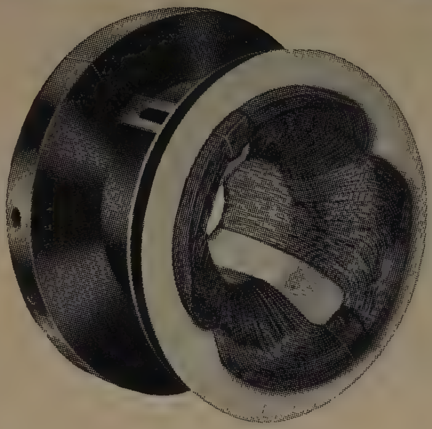


Send specifications for free sample and request new Arbor List of over 1500 sizes.

PRECISION PAPER TUBE CO.

2051 W. Charleston St. Chicago 47, Ill.
Plant No. 2, 79 Chapel St., Hartford, Conn.
Also Mfrs. of Precision Paper Tubes

DX *Announces* a NEW 90° YOKE for 27" TUBES



It's Engineered for TOP PERFORMANCE ... in Production *NOW!*

This new DX 90° Deflection Yoke has everything a television receiver manufacturer wants . . . a sharp full-screen focus, a minimum of pincushioning, the ultimate in compactness and a price that's downright attractive. Because this yoke has been brilliantly designed for mass production on DX's specialized equipment, it warrants immediate consideration in your 27" receiver plans. Write us today.

DEFLECTION YOKES . . . TOROID COILS . . . CRYSTALS
I. F. TRANSFORMERS . . . R. F. COILS . . . DISCRIMINATORS
SPEAKERS . . . TV TUNERS . . . ION TRAPS . . . TRANSFORMERS

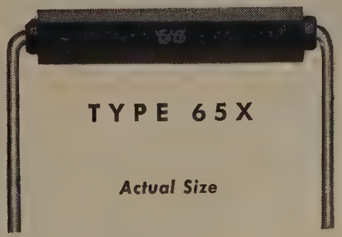
DX COMPONENTS
"the heart of a good television receiver"
TRADE MARK

DX RADIO PRODUCTS CO.
GENERAL OFFICES: 2300 W. ARMITAGE AVE., CHICAGO 47, ILL.

S·S·White MOLDED RESISTORS

The "All-Weather" Resistors

Of particular interest to all who need resistors with inherent low noise level and good stability in all climates



TYPE 65X

Actual Size

STANDARD RANGE

1,000 OHMS TO 9 MEGOHMS

Used extensively in commercial equipment including radio, telephone, telegraph, sound pictures, television, etc. Also in a variety of U. S. Navy equipment.

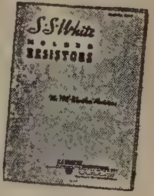
HIGH VALUE RANGE

10 to 10,000,000 MEGOHMS

This unusual range of high value resistors was developed to meet the needs of scientific and industrial control, measuring and laboratory equipment—and of high voltage applications.

SEND FOR
BULLETIN 4906

It gives details of both the Standard and High Value resistors, including construction, characteristics, dimensions, etc. Copy with Price List mailed on request.



THE S.S.White DENTAL MFG. CO. INDUSTRIAL DIVISION

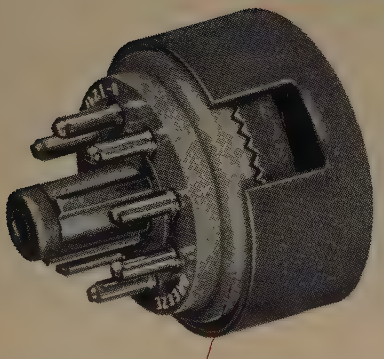
Dept. GR 10 East 40th St.
NEW YORK 16, N. Y.

WESTERN DISTRICT OFFICE: Times Building, Long Beach, Calif.

RUGGED as a RHINO... Quick as a Fox!

Two Special Purpose Connectors by

BREEZE MARK

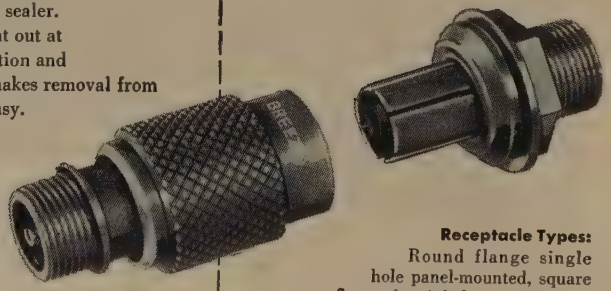


Battery Connectors

8-pin type for both A and B batteries used in all types of field communication equipment. "RUGGEDIZED" for extra security and long service life: polarizing stud is ALL METAL and all metal parts are cadmium plated and sealed with an iridite sealer. Cable may be brought out at any desired side position and locked. Handy bail makes removal from inaccessible places easy.

Quick Disconnect

Simply push male and female members together and lock. To disconnect with minimum resistance, pull back sleeve on plug shell and disconnect. Exceptionally low disengaging force required (less than 6 lbs., excepting pin friction). Vibration proof, moisture-proofed with synthetic rubber insert. Meets AN pin pattern and voltage requirements, in accordance with MIL C-5015. Plug shell and coupling sleeve are aluminum alloy, cadmium plated and iridite-sealed. (Federal Spec. QQP—416, Type 2.)



Receptacle Types:
Round flange single hole panel-mounted, square flange for 4 bolts, or specially flanged to specification. All contacts silver plated.

We invite your inquiries on any problems concerning connectors. Our wealth of engineering experience in this specialty is at your service.

BREEZE
CORPORATIONS, INC.
41 South Sixth Street, Newark, N. J.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

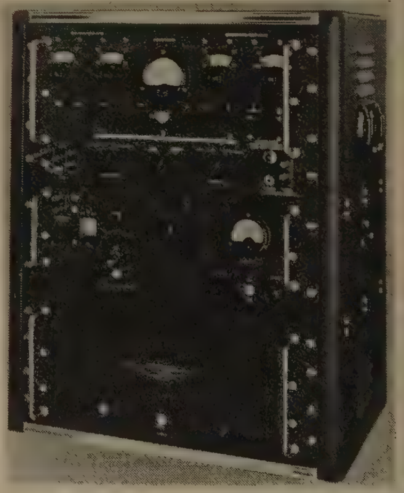
(Continued from page 124A)

Design and construction details make these decades ideal for laboratory use. Moisture resistant impregnated inductors are wound on molybdenum permalloy toroidal cores for high-Q and low external pickup. Each decade has complete electrostatic shielding. Full rotary switches for selecting inductance values have low contact resistance, laminated self-wiping contacts, and positive detents.

Specifications and prices for Type DE decade inductors are given in Lenkurt Bulletin DE-P2, available on request.

Noise and Distortion Analyzer

Empire Devices, Inc., 38-25 Bell Blvd., Bayside, L. I., N. Y., has a new noise and distortion analyzer (Model ND-110). It is an harmonic wave analyzer capable of measuring the mean power of complex signals (broad band) and the distribution of this power within the supersonic frequency spectrum (narrow band). It also determines signal-to-noise ratio, distortion and intermodulation characteristics of telephone transmission facilities, and supersonic devices.



Frequency range: 4 to 110 kc. Broad band sensitivity: −80 to +20 dbm, with accuracy of ±1 db. Narrow Band sensitivity: −110 to +20 dbm, with accuracy of ±2 db. Signal to interference ratio measurements: (a) sine wave signals 75 db. (b) complex (broad band) signals 65 db. Band pass characteristics: (narrow band). The instrument has an essentially flat pass band of 3,200 cps (±1,600 cps from center frequency by at least ±2,400 cps. The local oscillator is located in a thermostatically controlled oven for maximum stability.

(Continued on page 127A)

News—New Products

(Continued from page 126A)

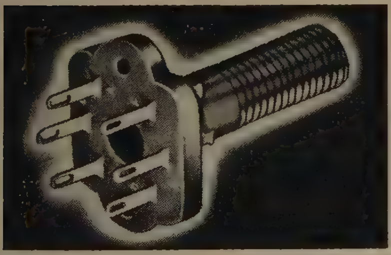
Capacity-Resistance-Inductance Bridge

The Clough-Brengle Co., Dept. P. 6014 Broadway, Chicago 40, Ill., has a new Model 712 capacity-resistance-inductance bridge.

This product is used to measure: the capacitance of paper, mica, electrolytic, ceramic and air capacitors; the stray capacitance of bushings, switches and wiring; the dissipation factor of capacitances; the leakage current of electrolytic capacitors; the resistance of composition and wire-wound resistors; the inductances of coils and transformers; the storage factor (Q) of inductances; the turns ratio of transformers; the insulation resistance of capacitors, bushings, and barriers; and the quality of capacitors already wired into a circuit.

Model 712 has accuracy, is small in size, and is of light weight. For information write to the company.

Glass-Bonded Mica RF Coil Form



Mycalex Corp. of America, Clifton Blvd., Clifton, N. J., announces a coil form that is injection-molded of Mycalex 410, glass-bonded mica insulation to provide permanently efficient operation under temperature conditions too high for Styrene and other plastic materials. The Mycalex 410 is able to withstand continuous ambient temperatures of over 650°F.

The features of this design include metal inserts, molded integral and precisely bonded to the dielectric in a manner that precludes any possibility of loosening due to the wide temperature changes and extremes encountered in this particular application.

(Continued on page 145A)

STANDARD
Radio Interference and Field Intensity
MEASURING EQUIPMENT
Complete Frequency Coverage—14kc to 1000 mc!

NM-10A

VLF
14kc to 250kc
Commercial Equivalent of AN/URM-6B.
Very low frequencies.

NM-20B

HF
150kc to 25mc
Commercial Equivalent of AN/PRM-1A. Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies. Has B.F.O.

NMA-5A

VHF
15mc to 400mc
Commercial Equivalent of TS-587/U.
Frequency range includes FM and TV Bands.

NM-50A

UHF
375mc to 1000mc
Commercial Equivalent of AN/URM-17.
Frequency range includes Citizens Band and UHF color TV Band.

These instruments comply with test equipment requirements of such radio interference specifications as MIL-I-6181, MIL-I-16910, PRO-MIL-STD-225, ASA C63.2, 16E4, AN-I-24a, AN-I-42, AN-I-27a, MIL-I-6722 and others.

STODDART AIRCRAFT RADIO Co., Inc.
6644-C Santa Monica Boulevard, Hollywood 38, California

Career Opportunities

●

ENGINEERS AND PHYSICISTS

Desiring the challenge of interesting, diversified, important projects—

Wishing to work with congenial associates and modern equipment and facilities—

Seeking permanence of affiliation with a leading company and steady advancement—

Will find these in a career here at GENERAL MOTORS.

●

Positions now are open in ADVANCED DEVELOPMENT and PRODUCT DESIGN, INDUSTRIAL ENGINEERING, TEST and TEST EQUIPMENT DEVELOPMENT.

- **COMMERCIAL AUTOMOBILE RADIO**
- **MILITARY RADIO, RADAR AND ELECTRONIC EQUIPMENT**
- **ELECTRONIC COMPONENTS**
- **TRANSISTORS AND TRANSISTOR AND VACUUM TUBE APPLICATIONS**
- **INTRICATE MECHANISMS such as tuners, telemetering, mechanical linkages, controls, etc.**
- **ACOUSTICS—loud speakers, etc.**

●

Inquiries invited from recent and prospective graduates as well as experienced men with bachelors or advanced degrees in physics, electrical or mechanical engineering, chemistry, metallurgy.

Salary increases based on merit and initiative.

Vacations with pay, complete insurance and retirement programs.

Location is in a low living cost center.

Relocation expenses paid for those hired.

●

All inquiries held in confidence and answered—WRITE or APPLY to

DELCO RADIO DIVISION
GENERAL MOTORS CORPORATION
Kokomo, Indiana

POSITIONS OPEN

The following positions of interest to I.R.E. members have been reported as open. Apply in writing, addressing reply to company mentioned or to Box No. . . . .

The Institute reserves the right to refuse any announcement without giving a reason for the refusal.

PROCEEDINGS of the I.R.E.
I East 79th St., New York 21, N.Y.

ENGINEER

The manufacturers of the UNIVAC—the first electronic, general-purpose digital computer system to be sold commercially—have interesting and important positions with challenging futures. Engineers and physicists are needed for work at all levels in many fields. Our rapidly expanding engineering and production programs have created many permanent positions paying excellent salaries. These positions offer outstanding opportunities for professional development. The possibilities for graduate study in this locality are excellent and the company's plan for reimbursement of tuition expenses is extremely liberal. Interviews arranged at our expense. Replies strictly confidential. Remington Rand Inc. Eckert-Mauchley Div. 2300 W. Allegheny Ave., Phila. 29, Pa.

ENGINEER—TEACHING

The University of Nebraska has 1 full-time teaching position open in the Electrical Engineering Dept. Salary range $3,200 to $4,600 depending upon education and experience. One interested in electronics desired. For details write to Prof. Ferris W. Norris, Chairman, Dept. of Electrical Engineering, University of Nebraska, Lincoln, Nebraska.

(Continued on page 130A)

A NEW Bendix Division!
A NEW Electronic Product!
NEW JOB OPPORTUNITIES

In our modern plant at York, Pennsylvania, this new division of Bendix Aviation Corporation is producing a new electronic product. This division has a big future; and this is *your* opportunity to get in on the ground floor, with excellent possibilities for rapid advancement. We need the following:

- **ELECTRONICS ENG.**
- **MECHANICAL ENG.**

Also We have many openings for men qualified by education or experience in all phases of electronics.

YOU BENEFIT With the Bendix York Division, you will benefit from high wages, paid vacations and holidays and ideal living conditions in a beautiful suburban area.

Write, Wire or Phone
Department Y-2

Bendix
AVIATION CORPORATION
YORK DIVISION

Phone: York 5521 York, Penna.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 127A)

Noise Analyzer

Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass., has a new, sound analyzer (Type 420A) which separates noise, sound, and vibration signals into their component frequency bands. Frequency analysis is equally as important as measurement of noise intensity for machinery and blower noise, industrial hygiene, and acoustical contracting applications. The high and low-pass filters of the new analyzer can be indepently adjusted in steps of ⅓ octave. A simple interlock permits the pass-band width to be fixed in any multiple of ⅓ octave. The position of this pass-band can then be adjusted throughout the audible range by a single control.

The analyzer includes a calibrated attenuator, an indicating meter meeting ASA standards, and an output jack for general purpose filter applications. The unit may also be used as an amplifier having a range exceeding 20 to 20,000 cps. The Analyzer weighs but 20 lbs. and is 10×10×6 inches. Bulletin on request to V. H. Pomper.

Relay

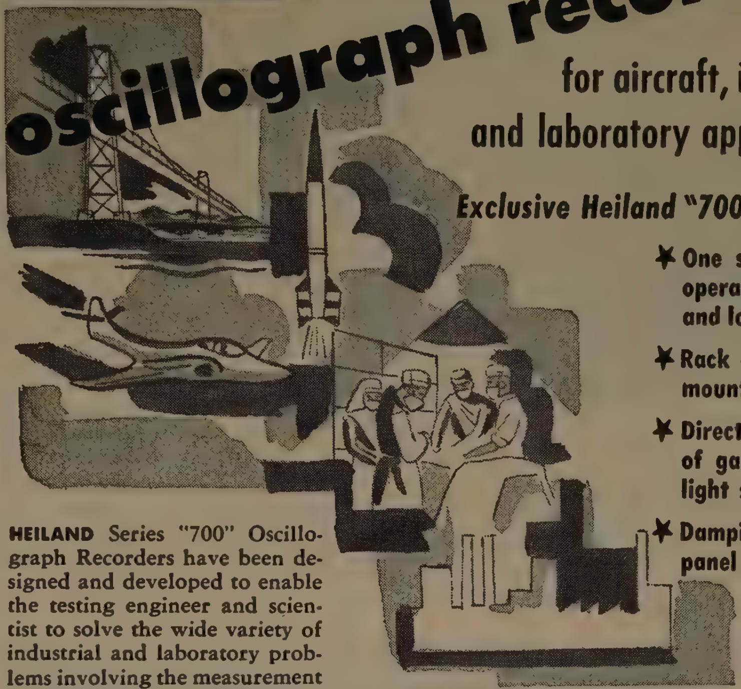
Neomatic, Inc., 9010 Ballanca Ave., Los Angeles 5, Calif., announces a new 50–500 cps relay of the dp dt type. Two models are offered, depending on contact rating. Model 10220 has a contact rating of 1 ampere, non-inductive; Model 10320 has a contact rating of 4 amperes, non-inductive. All units are hermetically sealed with dry air or inert gas to withstand severe environmental conditions and insure long life. Optimum operation is in temperature range −55°C to −85°C. Weight: 1.51 ounces (43 grams), Diameter 1.00 inch. Connects with 9 hook or 9 pin header. Vibration characteristics: withstands 20 Gs at 300 cps, contacts normally closed, unenergized. Acceleration characteristics: withstands steady-state acceleration up to 50 Gs. The ac relay is especially suited to aircraft use, but may be used for remote control mechanisms in almost all military or industrial applications.

(Continued on page 147A)

Heiland
DENVER

oscillograph recorders

for aircraft, industrial and laboratory applications



Exclusive Heiland "700" Features

- One surface operation, control and loading
- Rack or table mounting
- Direct monitoring of galvanometer light spots
- Damping resistor panel

HEILAND Series "700" Oscillograph Recorders have been designed and developed to enable the testing engineer and scientist to solve the wide variety of industrial and laboratory problems involving the measurement of physical phenomena such as strains, stresses, vibrations, pressures, temperatures, accelerations, impact, etc. Accurate and dependable oscillograph records permit the study of various recorded data comparatively, individually and collectively making for better product design and performance.

HEILAND Series "700" Oscillograph Recorders are being widely used today for the analysis of static and dynamic strains, vibrations, etc. in aircraft and guided missile flight testing; structural tests; performance tests; riding quality evaluation; voltage and current measurements; medical research; general industrial problem analysis.

A708 24-channel Oscillograph Recorders

Other "700" models up to 60 channels are available. Write today for a complete catalog of Heiland "700" oscillograph recorders.

The Heiland Research Corporation
130 East Fifth Avenue, Denver 9, Colorado

dependable instruments

Heiland
DENVER

SQUARE PULSE GENERATORS for the MILLIMICROSECOND to MICROSECOND RANGE

Model 100
Square Pulse Generator

PRICE: $395.00 F.O.B. New York
Standard Rack Mounting

For Nuclear Pulse Work, Radar, TV, Wide Band Amplifiers, and in the design, calibration and servicing of fast electronic systems:

FOR THE FIRST TIME—A Square Pulse Generator with a rise time of one millimicrosecond (10^{-9} seconds) and a pulse width which can be varied from 2 millimicroseconds to several microseconds is commercially available. Both positive and negative pulses of a 100 volts maximum amplitude, into low impedance (such as 50 OHM cable) are generated; the pulse amplitude can be varied from 100 volts to .006 volts in 1 decibel steps by means of selector switches on the front panel. One, two, or more pulse outputs, each of which can be individually attenuated and delayed are available in various models.

For further details, write for bulletin P-1 or contact our Engineering Division.

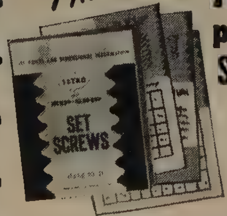
ELECTRICAL AND PHYSICAL INSTRUMENT CORPORATION

Sales and Business Office
25 West 43 Street
New York 36, N.Y.
Telephone: LOngacre 4-8510

Engineering Division
42-19 27th Street
Long Island City, N.Y.
Telephone: STillwell 4-6389

NEW SETKO Set Screw Catalog

NOW READY! FREE...



Your ANSWER to puzzling or regular SET SCREW PROBLEMS

Whether your application is a "puzzler" or just regular set screws, "right" in material, size, price and delivery—this Setko Catalog has the answer. A few highlights:

"NU-CUP" SET SCREWS—Read how they give greater holding power with same setting torque. Famous TV manufacturer has ordered over a million "Nu-Cups"!

ZIP-GRIP* SELF-LOCKING SET SCREWS—Catalog tells how ZIP-GRIP* is solving "vibration problem". No additional holding devices; exclusive "Contra-Thrust" action. Send for free ZIP-GRIP* Demonstrator and test samples.

HEXAGON SOCKET SET SCREWS—Read how Setko Socket Set Screws are milled from high-grade alloy steel bars heat-treated for maximum strength. Prices on all popular sizes, in stock.

BILLIONS OF SET SCREWS—New catalog contains results of our specialized experience making set screws for nearly 1400 manufacturers since 1935. Send for your FREE Copy.

FOR FREE CATALOG

Write your name and address in margin; tear out and mail to us today.

125

Set Screw & Mfg. Co.
422 Main St., Bartlett, Ill. (Chicago suburb)

*Pat. Pend.

We Specialize in Solving Puzzling Set Screw Problems

Positions Wanted

(Continued from page 144A)

ENGINEER

Degree 1948. 2 years design experience in aircraft electronic systems. 2 years design development of special equipment related to production of vacuum tubes. 1 year experience in field, lecturing and technical demonstration of television and test equipment. 3 years Army, telephone equipment and administration. Desires position in engineering administration. Box 635 W.

ENGINEER

BS physics June 1953. Sigma Pi Sigma, age 36. Entire college degree earned in part-time since marriage, 1 child. 3 years Army officer. Continuous employment in commercial/Army communications since 1935 (2 employers), 5 years marine operator, last 4 years TV broadcast with some supervisory work, remainder AM. Like TV but will consider allied fields. Box 636 W.

ELECTRONIC ENGINEER

Electronic engineer graduate Queen's University post graduate work McGill University Canadian Civil Servant with 12 years experience in systems engineering, project engineering, radar and pulse technique and fully conversant with implementation of Canadian Government defense contracts, desires suitable position in industry. Available 2 or 3 months after submitting resignation. Box 623 W.

STAFF ENGINEER

Reestablishing civilian career after military service. 10 years experience electronic design, instrumentation, production, and quality control. Established supervisory and administrative abilities. E.E. degree. Prefer location near Dallas, Denver, Kansas City. Box 629 W.

ENGINEER

SB-MIT 1945. Age 28, married, 2 children. Varied experience in servo-mechanisms, digital computers, helium liquefaction, and project engineering. Now on active duty with the U. S. Navy. Available April 1953. Desires technical liaison, sales, or administrative position in England or Europe. Box 630 W.

ENGINEER

BSEE 1950. Age 29, married. VHF-UHF receiver development and product design. Desires position in research and development in same field. Box 631 W.

ENGINEER

AB Physics 1949, MSEE Stanford University, 1951. Age 27. Married. 2 years Instructor in electrical engineering. Electronics speciality. Engineering education primary interest. Desires Assistant Professorship at smaller western university. Varied background in research and practical electronics. Box 634 W.

Positions Open

(Continued from page 137A)

PHYSICIST, PRODUCTION MANAGER SALES AND ELECTRICAL ENGINEERS,

(1) Sales Engineers with E.E. degree and 5 years capital goods selling experience. Knowledge of paper, plastics or rubber industry helpful. (2) Senior Project Engineer with E.E. degree and 5 years experience in direction of design projects for industrial electronic, servomechanism, or radar equipment. (3) Senior Research Engineer with Ph.D. or equivalent in physics or engineering, and 5 years experience in direction of radio-chemistry, physics and electronic systems analysis. (4) Production Manager with E.E. degree and 5 years experience in supervision of electronic and mechanical production including production and materials planning. Salaries open. Send complete resume. Box 718.

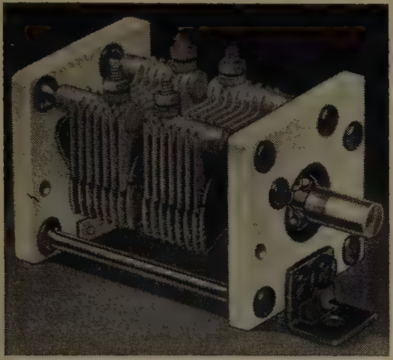
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 145A)

VHF-UHF Variable Capacitor

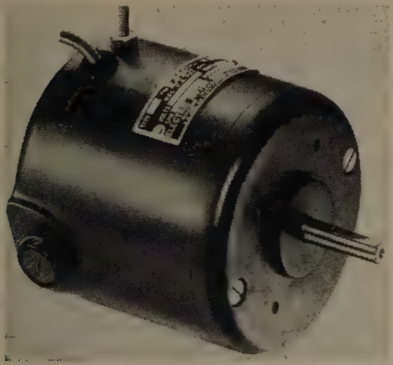
A VHF-UHF variable capacitor designed for tuned circuits operating at frequencies from 50 mc to 500 mc is being introduced by the **Hammarlund Manufacturing Co., Inc.**, 460 W. 34th St., New York 1, N. Y.



This capacitor, called the VU, incorporates a unique design which places two capacitor sections in series and eliminates the need for contacts to the rotor. The rotor is completely isolated by the use of pyrex glass ball bearings. As a result of this construction, contact and bearing noise is completely eliminated. The series arrangement also permits a more symmetrical design of the capacitor and consequently allows better circuit layout.

Blower or Fan Motor

The **Electrical Motor Corp.**, Div., Howard Industries, Inc., has a new version of the EMC Model 700 motor known as Model 710. Specifically designed for use as a blower or fan motor for refrigeration space cooler or space heater applications.



The EMC 710 is series wound and can be furnished either ac or dc, and has a range of 6, 12, 24, 32 volts to 115 volts.

Currently used as a jeep heater motor, this model is rated from 1/30 hp to 1/15 hp. The case, totally enclosed type, will stand water submersion and a wide range of temperature changes. Mounting is either band or flange type.

This motor is ruggedly built for long life and trouble-free performance, and is available with permanently grease-sealed sleeve bearings or precision ball bearings. For complete information, write **Howard Industries, Inc.**, Racine, Wis.

(Continued on page 148A)

VICTOREEN'S

VOLTAGE REGULATOR TUBES

Replace expensive electronic regulating circuits.

- **RELIABLE**
- **LONG LIFE**
- **SPACE SAVING**

For applications requiring reliable voltage regulation in low current circuits . . . Consider the advantages of a single tube to perform one of these vital functions:

Voltage regulation of power supplies.
Voltage reference for control of higher currents.
Voltage limiting to prevent circuit overloading.
Voltage adjustment for fine control of precision power supplies.

Write for additional specifications.

GLOW TUBES 57 Volts	Maximum Current 800 μa Regulation 200-800 μa is 3.0%
HIGH VOLTAGE REGULATORS 400 to 2500 Volts	Maximum Current 100 μa Regulation 5-55 μa is 1.5%
HIGH VOLTAGE REGULATORS 3000 to 5000 Volts	Maximum Current 250 μa Regulation 5-55 μa is 1.5%
HIGH VOLTAGE REGULATORS 5000 to 15,000 Volts	Maximum Current 100 μa Regulation 10-60 μa is 1.5%
ADJUSTABLE REGULATORS 645 to 705 Volts	Maximum Current 55 μa Regulation 5-55 μa is 3%

Plan to visit our booths, 4103 and 4104, at the 1953 IRE show, New York City.

DISTRIBUTORS

Allied Radio Corp., Chicago
Gifford-Brown, Des Moines
Harrison Equipment Co., Houston
Radio Shack Corp., Boston
Terminal Radio Corp., New York City
W and W Distributing Co., Memphis

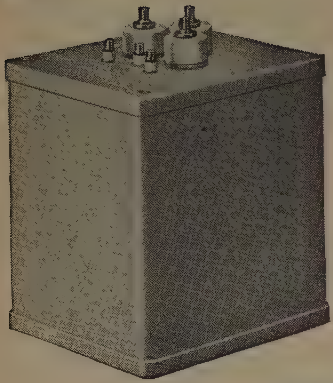
WEST COAST REPRESENTATIVE
Carlton Engineering Co., Los Angeles

BETTER COMPONENTS MAKE BETTER INSTRUMENTS

The Victoreen Instrument Co.

3800 PERKINS AVE. • CLEVELAND 14, OHIO

Quality COMES FIRST



• If performance and long life are the primary factors in your application of transformers, then submit your specifications to Acme Electric. Quality comes first in every Acme Electric transformer.

ACME ELECTRIC CORPORATION
442 WATER STREET • CUBA, N. Y.

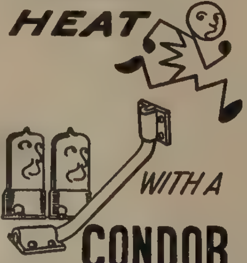
Acme ACME Electric
TRANSFORMERS

Come Again
to the 1953 IRE
Radio Engineering Show
March 23-26, New York

HEAT
REDUCES
COMPONENT
LIFE

PERMANENT, TROUBLE-FREE
EASY TO INSTALL
FINE FOR POTTED UNITS
STOCK UNITS 6,9 & 12 INCHES
3/16" DIA. 10 WATTS
1/4" DIA. 20 WATTS
3/8" DIA. 50 WATTS
SAMPLE $5 - CIRCULAR FREE

REMOVE
HEAT



WITH A
CONDOR
COOLER
PAT. APPLIED FOR

CONDOR RADIO MFG. CO.
2705 S. KRAMER
TUCSON, ARIZ.

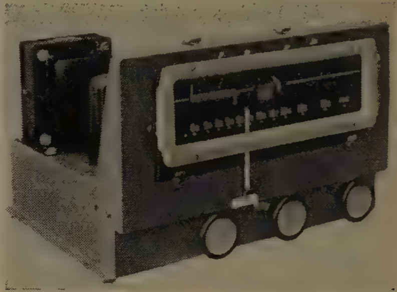
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 147A)

FM Tuner

A new FM tuner is being produced by **Browning Labs., Inc.** 750 Main St., Winchester, Mass. The new tuner (Model RV-31) features an all-triode rf section and follows the Armstrong receiving method with dual-cascade limiters for most effective noise quieting. Input signals of 3 microvolts will produce 20 db of quieting. AFC locks the local oscillator into correct tuning and may be switched off if desired. A selector switch permits FM, Phono, TV, or recorder playback to be fed through the tuner volume control to the main amplifier.

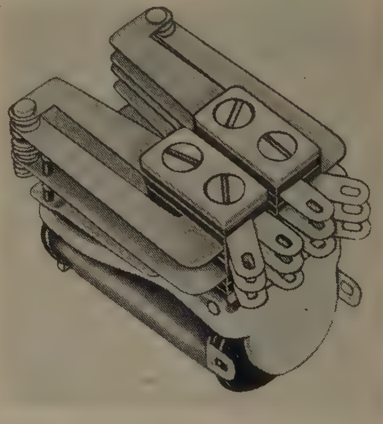


The RV-31 is 11 inches wide, $9\frac{3}{8}$ inches deep, and $6\frac{1}{2}$ inches high. Full 15 kc audio output is fed through a cathode follower output stage at very low distortion; less than 0.25 per cent at 25 kc modulation swings. Long cable runs are possible at the low impedance output without affecting high frequency response.

The RV-31 has a self contained power supply and has ac power outlets at the rear of the chassis to facilitate powering turntables and amplifiers. Weight is 10 pounds.

Miniature Telephone Type Relays

Newly developed MJ Series miniature telephone relays, have been announced by **Potter & Brumfield**, Princeton, Ind.



A new type of construction features longer, more flexible contact arms that result in a lower spring load rate. This com-

(Continued on page 150A)

ZOPHAR
---WAXES
---COMPOUNDS

Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types; radio, television, etc. Cold flows from 100°F. to 285°F. Special waxes non-cracking at —76°F. Compounds meeting Government specifications plain or fungus resistant. Let us help you with your engineering problems.

ZOPHAR MILLS 107 YEARS EXPERIENCE

ZOPHAR MILLS, INC.
112-130 26th Street,
Brooklyn 32, N. Y.

BE SAFE WITH
Q-max
A-27
LOW-LOSS LACQUER & CEMENT

- Q-Max is widely accepted as the standard for R-F circuit components because it is chemically engineered for this sole purpose.
- Q-Max provides a clear, practically loss-free covering, penetrates deeply, seals out moisture, imparts rigidity and promotes electrical stability.
- Q-Max is easy to apply, dries quickly and adheres to practically all materials. It is useful over a wide temperature range and serves as a mild flux on tinned surfaces.
- Q-Max is an ideal impregnant for "high" Q coils. Coil "Q" remains nearly constant from wet application to dry finish. In 1, 5 and 55 gallon containers.

Communication Products Company, Inc.
MARLBORO, NEW JERSEY
(MONMOUTH COUNTY)
Telephone FReehold 8-1880
C/P

Standing
Room
Only

Sold
Right
Out

We're sorry, but we think it's only fair to tell possible new customers our Standing Room Only sign must be changed to Sold Right Out!

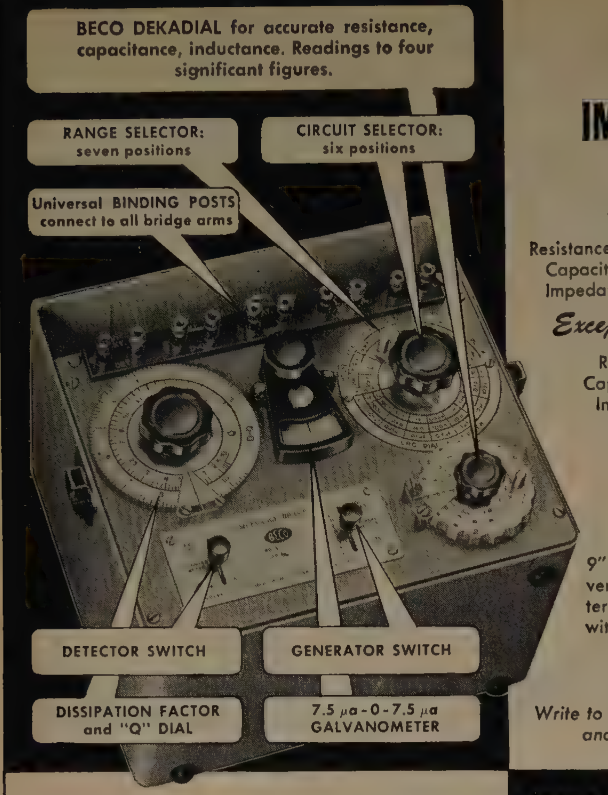
The design and production facilities of our microwave department are now taken over by the increasing requirements of our present customers. Because of our responsibility to them, this situation may continue quite a while.

We are sorry to say this because we enjoy making new friends. But we feel that we should tell those who might be interested in our engineering and manufacturing facilities, that for some time we may not be able to serve them.

Any change in the situation will be announced in this publication.

LHT
TRADE MARK

L. H. TERPENING COMPANY
DESIGN • RESEARCH • PRODUCTION
Microwave Transmission Lines and Associated Components
16 West 61st St. • New York 23, N. Y. • Circle 6-4760


BECO DEKADIAL for accurate resistance, capacitance, inductance. Readings to four significant figures.
RANGE SELECTOR: seven positions
CIRCUIT SELECTOR: six positions
Universal BINDING POSTS connect to all bridge arms
DETECTOR SWITCH
GENERATOR SWITCH
DISSIPATION FACTOR and "Q" DIAL
7.5 μa-0-7.5 μa GALVANOMETER

BECO

IMPEDANCE BRIDGE

Wide Range

Resistance: 1 milliohm to 11 megohms
Capacitance: 1 mmf to 1100 mfs.
Impedance: 1 mh to 1100 henrys

Exceptional Accuracy

Resistance: ±0.1%
Capacitance: ±0.25%
Inductance: ±1.0%

SHOWN
MODEL 250-C1
$340

9"x11"x11" over-all. Convenient operation from battery, or from AC power lines with Beco accessory amplifier

Write to factory for literature and analysis of your needs.

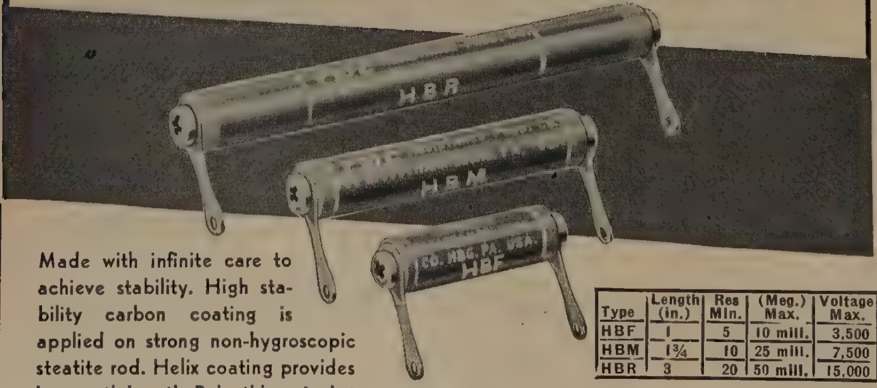
BROWN ELECTRO-MEASUREMENT CORP.

4635 S. E. HAWTHORNE BLVD.
PORTLAND 15, OREGON

rpc HIGH *MEGOHM* RESISTORS

FOR DEPENDABLE PERFORMANCE UP TO

50 MILLION MEGOHMS



Made with infinite care to achieve stability. High stability carbon coating is applied on strong non-hygroscopic steatite rod. Helix coating provides long path length. Polyethlene jacket protects against mechanical damage and humidity. Polarization effects and noise level extremely minute. Easily mounted.

Type	Length (in.)	Res Min.	(Meg.) Max.	Voltage Max.
HBF	1	5	10 mill.	3,500
HBM	1¾	10	25 mill.	7,500
HBR	3	20	50 mill.	15,000

Tolerance is ± 10%. Also available ± 5%; ± 2% to 10,000 meg. in matched pairs.

RESISTANCE PRODUCTS CO.
714 RACE STREET • HARRISBURG, PA.

rpc

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 148A)

bination permits wider contact gap, more overtravel, improvement in sensitivity, faster action and longer life.

These relays are available, either open or hermetically sealed, with a maximum of four Form C contacts for either dc or 60 cps ac operation. Coils are furnished up to a minimum resistance of 22,000 ohms. Insulation resistance is better than one thousand megohms and breakdown tests at 500 v rms.

Open relay measures 1 inch wide, 1 17/32 inches long, by 1 3/16 inches high.

Complete information available on request.

Metals Catalog

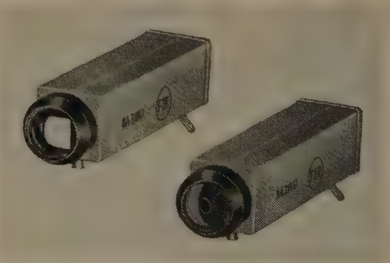
General Plate Div. of Metals & Control Corp., Attleboro, Mass., has an illustrated, twelve-page catalog which describes the various composite metals, precious metals, electrical contacts, and Truflex metals manufactured by the company. In addition, it explains the various products which it fabricates.

Its contents cover some of the unusual composite metals which General Plate has recently developed. Information on the platinum-group metals and manganese age-hardening alloys is given. Of unusual interest are the two sections which cover thin gauge rolling and mirror finish rolling.

Copies of the catalog are available by writing direct to the company.

Magnetic Signal

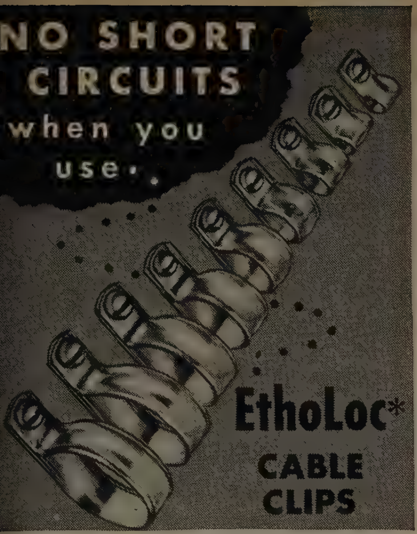
Federal Telephone & Radio Corp., Clifton, N. J., associate of the International Telephone and Telegraph Corp., has announced the development of a new magnetic signal capable of providing both visual and audible indication.



Designed for fast indication, long life, and dependable performance under rugged conditions, this sturdy, compact magnetic unit supplants the mechanical operation common to the old-type drop signal. It is ¾ inch square×3½ inches long, and operates on 8 ma ac in series with selenium-rectifier equipment or its equivalent. The unit is equipped with a contact for an audible signal when required.

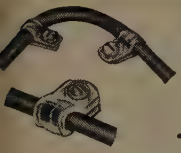
In addition to being dust- and moisture-proof, the new signal is nonpositional and constructed to withstand severe vibration. It has high sensitivity, a luminous face indicator which is clearly visible day or night, and the signal is mechanically restored. The new Federal unit meets military requirements.

(Continued on page 152A)



EthoLoc*
CABLE CLIPS

*TRADE MARK PAT. PEND.



ALL SIZES
⅛" dia. to 1¼" dia.

Made of
TOUGH, DURABLE
ETHYL CELLULOSE PLASTIC
—FLEXIBLE, EASY TO INSTALL

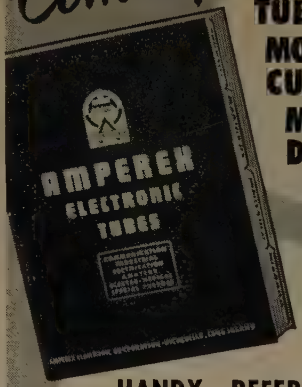
Write for Sample and Full Information, including Strength Tests and Prices

WECKESSER CO.

ALSO MFRS. OF ALL NYLON CABLE CLIPS

5269 N. Avondale Ave. • Chicago 30, Ill.

Coming! MORE TUBES! MORE CURVES! MORE DATA!



New

1953

HANDY, REFERENCE-SIZE

AMPEREX

TUBE CATALOGUE

A "must" volume for all radio, television and industrial electronics engineers and laboratories. It's now in preparation. Watch for our announcement of its availability.

AMPEREX ELECTRONIC CORP.
230 DUFFY AVE., HICKSVILLE, L. I.
In Canada and Newfoundland: Rogers Majestic Limited
11-19 Brentcliffe Rd., Leaside, Toronto, Ontario, Can.
Cable: "AMPRONICS"

Come — To The 1953 Radio Engineering Show March 23-26, Grand Central Palace, New York City.

See — 405 Exhibits—A preview of Radio Electronic Progress

Hear — 220 Papers in 43 skillfully organized Sessions.

Plan — To Attend—Reserve that Hotel Room Today.

OP HAT RETAINERS

An improved clamp that holds electron tubes, relays, capacitors and pluggable components in position.

RITE FOR FREE CATALOG

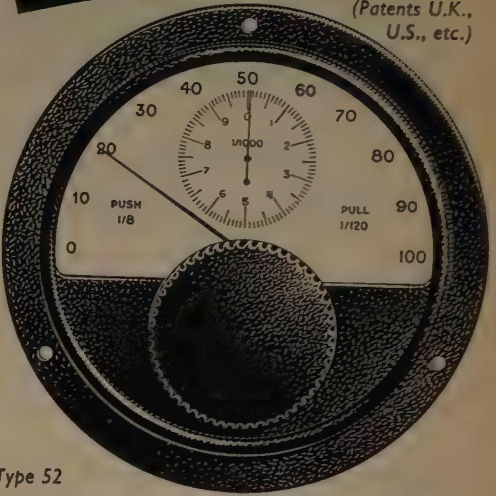
EASY TO APPLY
INSTANTLY RELEASED
POSITIVE LOCKING ACTION

IMES FACSIMILE CORPORATION
540 West 58 St., New York 19, N. Y.
1523 L St., N.W. Washington 5, D. C.

MICRODUAL

TWO-SPEED PRECISION DRIVE

(Patents U.K., U.S., etc.)



Type 52

TWO SPEEDS · SINGLE CONTROL
FREE OF BACKLASH

Accuracy of scale reading 100%

Coarse searching speed plus fine setting control.

Single control knob displaced axially to select the speed ratio.

Spring-loaded gears with automatic take-up of any wear or play between primary and secondary drives.

Pointers geared directly to centre spindle.

Security in operation: friction clutch obviates overdriving.

TYPE No.	NUMBER OF DIAL MARKINGS	EFFECTIVE SCALE LENGTH	SPEED RATIOS	
			COARSE	FINE
52	1,000	3.3 feet	1 : 8	1 : 120
63	1,000	3.3 feet	1 : 8	1 : 120
57	2,000	6.6 feet	1 : 15	1 : 200
56	2,000	6.6 feet	1 : 15	1 : 200
53	2,000	6.6 feet	1 : 15	1 : 200

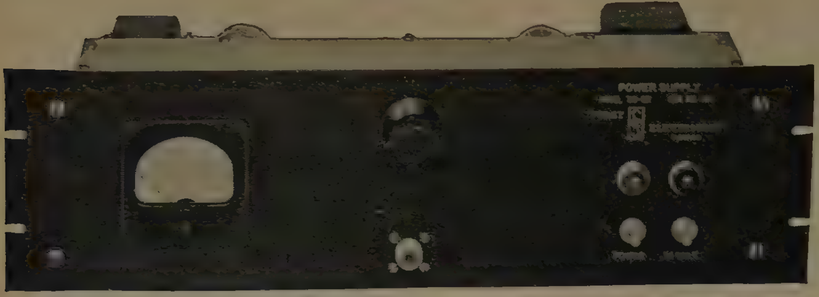
We are specially organized to handle direct enquiries and orders from U.S.A.
Billed in dollars. Settlement by your check.

CABLE OR AIRMAIL TO-DAY

TRANSRADIO LTD
CONTRACTORS TO H.M. GOVERNMENT
138A CROMWELL ROAD, LONDON, S.W.7., ENGLAND
CABLES — TRANSRAD, LONDON

1500 VOLT Regulated POWER SUPPLY

For Photo-Multiplier Tubes



Front View of Model 710-PR Power Supply

Continuously Adjustable from
600 to 1500 V.D.C. at 0.1 Milliamperes

POSITIVE TERMINAL GROUNDED

Regulation: Output voltage varies less than .01% per volt change of line voltage. Output voltage varies less than 1 volt with variations of output current between 0-1 milliampere. (Internal impedance less than 1000 ohms.)

Model 710P
Cabinet Mounted
$190.00*
MODEL 710PR
Standard Rack
Mounting
$195.00*

Also available with 2 or 3 independently regulated and independently adjustable outputs.
Write for Descriptive Bulletin

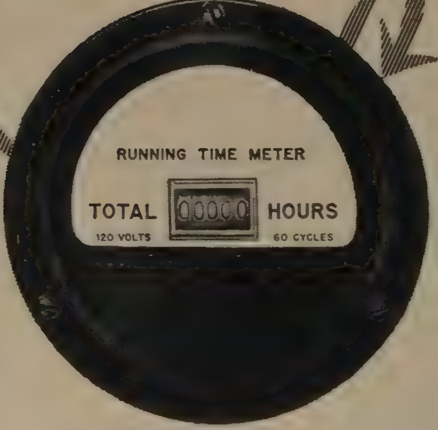
Models Available With Negative Terminal Grounded (Substitute letter "N" for "P" in model designation).
**Prices net F.O.B. Chicago*

FURST ELECTRONICS
3326 W. Lawrence Ave., Chicago 25, Illinois

Burlington

HERMETICALLY SEALED
RUNNING
TIME
METER

- DESIGNED
- ENGINEERED
- MANUFACTURED for PRECISION PERFORMANCE



• Designed for use on AC lines where successful servicing of electronic or electrical equipment depends upon the regular servicing of such equipment based on actual operating (or idle) time. Unit has a range of 9999.9 hours and resets automatically at 10,000 hours. Can be supplied for either 120 or 240 volts. 60 cycle operation and has operating temperatures of —55 to +55° C.

Running Time Meter is available 3" square or 3½" round Bakelite case or 3½" round hermetically sealed case.

- 9999.9 hour range
- 10,000 hour automatic reset
- —55 to +55°C. operating temperature

Write Dept. I-23 for further details.

BURLINGTON INSTRUMENT COMPANY
DEPT. I-23, BURLINGTON, IOWA

News—New Products

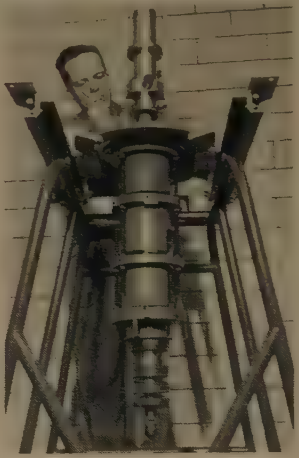
These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 150A)

Klystrons

The General Electric Co., Tube Dept., Schenectady, N. Y., has added six high-power klystron tubes to its transmitting-tube line and will begin production of the tubes at its Schenectady plant early this year.

Production of the tubes, most powerful yet developed for uhf telecasting, has been centered at the San Carlos, Calif., plant of **Varian Associates, Inc.,** who developed them to G-E specifications.



The tubes are rated for a maximum power output of 15 kw with a synchronizing peak level of 12 kw.

Each of the six tubes is rated for a specific uhf range. Together they cover all uhf channels, from 470 to 890 mc. Each tube is tunable and contains three resonators. All six are integral cavity tubes, which will mean that the transmitter manufacturer will not have to provide cavities for his final amplifier tubes.

The tubes will provide a power gain of about 200 in broad-band television service, reaching a synchronizing level of 12 kw from as little as 60 watts of excitation power.

They have unipotential bombardment-heated cathodes made of pure tantalum, collectors which can dissipate 51 kw, and require electromagnetic focusing of the electron beam. The cathode seals and the output seals are forced-air cooled. The drift tubes and the collectors are water cooled.

Maximum ratings for the tubes as rf amplifiers in broadbeam television service: dc beam voltage, 18 kv; dc beam current, 3.25 maximum amperes; collector dissipation, 51 kw; drift tube collection current, 250 ma; driving power, 150 watts.

Typical operating data for six megacycle bandwidth: dc beam voltage, 17 kv; dc beam current, 2.5 to 3 amperes; driving power, synchronizing level, 60 watts; driving power, pedestal level, 33.7 watts; power output, saturation level, 15 kw; power output, synchronizing level, 12 kw; power output, pedestal level 6.72 kw.

(Continued on page 155A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 152A)

Vertical Deflection Amplifier

A miniature, high perveance, double triode, vertical deflection amplifier is now in production at the **Radio Tube Div., Sylvania Electric Products Inc.,** Emporium, Pa. The tube has been designated Type 12BH7.

The unit consists of two completely independent medium mu triodes in a T-6½ envelope. One section may be used as the sawtooth generator, while the other section serves as the vertical deflection amplifier. Both sections are designed to withstand the high pulse voltages normally encountered in vertical amplifier service. For certain applications where the plate supply voltage must be kept low, parallel connection of the two sections may be used. The heater of the Type 12BH7 is designed to operate from either 6.3 or 12.6 volts.

Oscillators

A series of high-stability master oscillators for use in the laboratory or as a frequency source for radio transmitters and receivers has been announced by **Wunderlich Radio Co.,** 2 Fifth Ave., New York 11, N. Y. There are three models which cover the following ranges: 200–600 kc, 500–1640 kc and 1/16 mc. A stability of 5 parts per million is attainable and a resetability of the same order is featured, thus making it unnecessary to reference the frequency against a master standard. Other models available up to 1,000 mc on special order.

Power output of 2 to 5 watts across a 75 ohm load is provided, which permits full excitation of most radio transmitters. The oscillators are supplied with a cabinet for table top mounting. The primary power source is 115 v, 50–60 cps.

(Continued on page 156A)

HYCOR
TYPE 4200
Sound Effects Filter

This unit has been developed to meet present day requirements for compactness. The filter requires only 3½ inches of rack space.

Features . . .
- **LOW HUM PICKUP** through the use of toroid coils. The unit may be used in circuits having signal levels as low as —40 dbm without the necessity for taking special precautions against hum pickup.
- **LOW DISTORTION:** The filter may be used at levels up to plus 20 dbm with negligible intermodulation distortion.
- **RELIABILITY:** All capacitors and inductors are hermetically sealed for lifetime service. Aging effects are negligible.

General Specifications . . .

DIMENSIONS:	Standard rack panel, slotted, 3½" high. Maximum depth 7½".
CONTROLS:	Low frequency cutoff selector knob, high frequency cutoff selector knob, on-off key.
RANGES:	Both low and high frequency cutoff controls cover 100, 250, 500, 1000, 2000, 3000, 4000 and 5000 cycles.
ATTENUATION:	Approximately 16 db, per octave on both high and low frequency cutoff points.
IMPEDANCE:	500/600 ohms, in-out.
FINISH:	Engraved panel finished in medium gray baked enamel. (Special colors available upon request.)
	The filter has standard input and output jacks located on the front panel in addition to the terminal block at the rear.

11423 VANOWEN ST., NORTH HOLLYWOOD, CALIFORNIA HYCOR Company, Inc. SUnset 3-3860

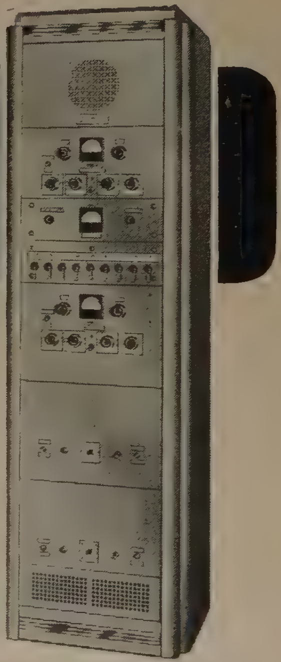
Manufacturers of Precision Resistors, Toroid Inductors and Electric Wave Filters

REPRESENTATIVES:
Jack Beebe, 5707 W. Lake Street, Chicago, Illinois
George E. Harris & Co., Box 3005, Municipal Airport, Wichita, Kansas
Marvin E. Nulsen, 5376 E. Washington St., Indianapolis 19, Indiana
Burlingame Associates, 103 Lafayette Street, New York City

For further information contact your nearest Hycor representative or write for Bulletin S

TAKE NO CHANCES WITH VITAL EQUIPMENT... *Specify*

SERIES 6918 or 6924
RACKS
by PAR-METAL



Our P-6924 Rack as used by Gai-Tronics, Inc., Reading, Pa.

18½" or 24" DEEP, for 19" WIDE PANELS
- *Panel Spaces:* 61¼", 70", or 77" high.
- Finished in Prime Coat, Black Wrinkle, Grey Lacquer, Grey Wrinkle.
- Series 6918 or 6924 Racks may be used in "rows" or "gangs," as corner trims are removable from front of cabinet.
- Standard shelves and roller trucks are manufactured by us for use with these Racks.

THESE RACKS ARE MODERATELY PRICED and AVAILABLE FOR SHIPMENT FROM STOCK

Planning an electronic product? Consult Par-Metal for
RACKS • CABINETS
CHASSIS • PANELS

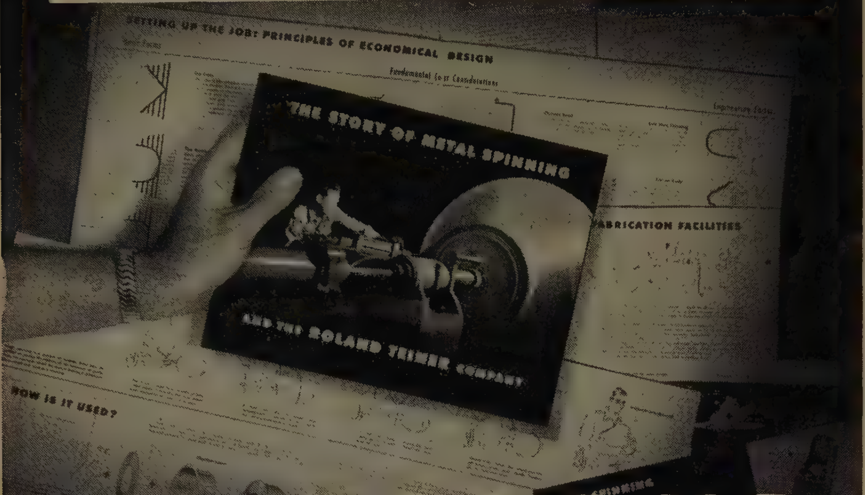
Remember, Par-Metal equipment is made by electronic specialists, not just a sheet metal shop.

Made by Electronic Specialists!

PAR-METAL
PRODUCTS CORPORATION
32-62 — 49th ST., LONG ISLAND CITY 3, N. Y.
Tel.: AStoria 8-8905
Export Dept.: Rocke International Corp.
13 East 40 Street, New York 16, N. Y.

WRITE FOR CATALOG!

WRITE FOR "THE STORY OF METAL SPINNING." Find out how engineers design for lower costs; how to use the Teiner experimental shop and how Teiner provides all-gauge — all-metal — any-quantity spinning for industry. Read about this spinning shop, now largest in the east and tops in scientific experimental spinning. ***Ask for Brochure 52 E.***


SETTING UP THE JOB: PRINCIPLES OF ECONOMICAL DESIGN
THE STORY OF METAL SPINNING
AND THE ROLAND TEINER COMPANY
FABRICATION FACILITIES
HOW IS IT USED?

ROLAND TEINER CO. INC. METAL SPINNING

ROLAND
TEINER
COMPANY, INCORPORATED
134 TREMONT ST., EVERETT 49, MASS. Tel. EV 7-7800

"Back home in Indiana"

I.D.E.A., Inc., is looking for a design engineer. Someone who would like to make Indianapolis his permanent home—who would like to work for a young, forward looking company that is already the leader in its field. If you are that man, address full information about yourself to: R. A. Morris, Chief Engineer, I.D.E.A., Inc., 7900 Pendleton Pike, Indianapolis 26.

Makers of the Regency VHF Booster, UHF Converter and other electronic devices.

Regency

INDIANAPOLIS, INDIANA

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 155A)

Capacitor Bulletin

A "High-Temperature Metalized-paper Capacitors" bulletin is available from **Aerovox Corp.,** New Bedford, Mass. It deals with the performance characteristics of such capacitors, including facts, figures, and graphs on rated voltages, temperature range, insulation resistance, nominal capacitance, power factor, vibration, humidity, life test, etc., also available types and listings.

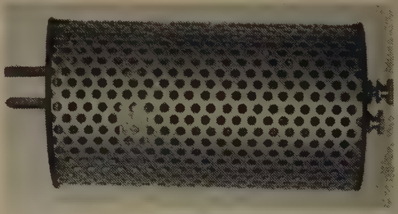
Selenium-Rectifier-Circuit Electrolytics

For the filtering function in selenium-rectifier circuits, several twist-prong base electrolytic capacitors, designated as Type AFHS, are announced by **Aerovox Corp.,** New Bedford, Mass., and have been made available to and through distributors.

While these selenium-rectifier electrolytics look exactly like the usual AFH twist-prong electrolytics, there are important departures in internal construction. The usual electrolytics are not always suitable in selenium-rectifier circuits, due to high ripple currents. However, Aerovox engineers have studied the operating conditions as well as the Howard Sams' recommendations in listing numbers used as initial equipment by leading TV set manufacturers and for replacement purposes. The selection does not duplicate any of the numbers that can be used from the usual AFH series.

Power Supplies

The Jersey City Technical Labs., 880 Bergen Ave., Jersey City 6, N. J., announces the addition to its line of two "Mini-Pack" power supplies. The "Mini-Pack" is designed to plug into a standard ac female receptacle. Power is available at screw terminals which are extra long so that spade leads or alligator clips may be readily affixed.



Model R "Mini-Pack" gives 108 volts regulated low ripple dc with an OB2 voltage regulator tube. It will maintain constant voltage output with load variations up to 15 ma, or lightly loaded with input variations from 100 to 130 volts ac.

Model P "Mini-Pack" is a voltage doubler, 10 watt power source, of low ripple dc. The no load voltage output is 330 volts. At 50 ma, the maximum constant duty current, the output is 200 volts. For intermittent use, the current may go as high as 65 ma.

(Continued on page 157A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 156A)

Switching Key

A new miniature anti-capacity switching key which weighs 2⅛ ounces and combines compactness with increased reliability and long-life has been announced by **Federal Telephone & Radio Corp.,** Clifton, N. J., associate of International Telephone & Telegraph Corp.

Designed to meet military requirements, the new key provides more contacts in less space and is ideal for use in airborne and other types of equipment where compactness and light weight are prime factors.

The unit consists of four sets of transfer contacts on each side and provides superior transfer. The key is nonlocking in both directions. It is mounted on an aluminum frame with four screws and can be easily removed from the key frame for inspection and adjustment. Other features include a molded spring nest and a special restoring spring heat-treated for maximum life and endurance.

There is Always One Leader in Every Field

BODNAR INDUSTRIES, Inc.

leads in the field of

TRANSILLUMINATED PLASTIC LIGHTING PLATES

BECAUSE OF *Quality* • *Uniformity* • *Performance*

Design & Layout "Know-How Service"

Quantity Production Promptly

NEW YORK —19 Railroad Ave., New Rochelle (Home Office)
TEXAS —Jefferson Tower Building, Dallas
CALIFORNIA—11056 Cumpston St., N. Hollywood
CANADA —313 Montreal Trust Bldg., 67 Yonge St., Toronto

SPECIMEN PANEL MIL-P-7788 (AN-P-89) SENT ON LETTERHEAD REQUEST

FS MICROMETER HEAD

for the Electronics Industry

ELECTRONIC ENGINEERS PRAISE FS MICROMETER HEADS FOR THEIR PRECISE ACCURACY EVEN AFTER LONG HARD USAGE. THIS ACCURACY IS MADE POSSIBLE BY A PATENTED THREAD-FORM WITH RADIALLY-LOADED NUT FOR ELIMINATION OF BACK-LASH, AND AUTOMATIC WEAR COMPENSATION . . . OTHER FEATURES AND SPECIFICATIONS ARE DESCRIBED IN OUR NEW BULLETIN, OBTAINABLE ON REQUEST.

2

FREQUENCY STANDARDS

P. O. BOX 66, EATONTOWN, N. J. • TELEPHONE ASBURY PARK 1-1018

Over 85% of the torque wrenches used in industry are

STURTEVANT

TORQUE WRENCHES

Read by Sight, Sound or Feel.

- Permanently Accurate
- Practically Indestructible
- Faster—Easier to use
- Automatic Release
- All Capacities

in inch ounces . . . inch pounds . . . foot pounds (All Sizes from 0-6000 ft. lbs.)

Every manufacturer, design and production man should have this valuable data. Sent upon request.

P.A. STURTEVANT CO.
ADDISON QUALITY ILLINOIS

DC to AC Converters
Dynamotors
Genemotors
Recorder Converters
Inductor Alternators
Magmotors

DEPENDABLE . . . COMPACT . . . EFFICIENT

Carter *Rotary Power*

Carter DC to AC Converters, Dynamotors, Genemotors, Magmotors, and Inductor Alternators (inverters) are made in a wide variety of types and capacities adaptable to communications, laboratory, and industrial applications, of many kinds. Widely used in aircraft, marine, and mobile radio, geophysical instruments, laboratory work, ignition, timing and many other uses.

Carter Motor Co.

2645 N. Maplewood Ave., Chicago 47

Sales Offices in Principal Cities

*Trade Mark Registered

MAIL COUPON FOR CATALOGS

Please send catalogs containing complete information on Carter Rotary Power Supplies.

Name____________________________

Address__________________________

City________________State________

PROFESSIONAL CARDS

ALFRED W. BARBER LABORATORIES

Specializing in the Communications Field and in Laboratory Equipment

Offices, Laboratory and Model Shop at:
32-44 Francis Lewis Blvd., Flushing, L.I., N.Y.
Telephone: Independence 3-3306

CROSBY LABORATORIES, INC.

MURRAY G. CROSBY & STAFF
RADIO-ELECTRONIC RESEARCH
DEVELOPMENT & MANUFACTURING
COMMUNICATIONS, FM & TV
ROBBINS LANE
HICKSVILLE, NEW YORK
HICKSVILLE 3-3191

ELDICO OF NEW YORK, INC.

Donald J. S. Merten and Engineering Staff
Consultants on Interference Elimination from Transmitters, Induction Heaters, Diathermy, etc.

44-31 Douglaston Parkway, Douglaston, L.I., N.Y.
Bayside 9-8686

Richard B. Schulz

Electro-Search

Radio-Interfeernce Reduction;
Development of
Interference-Free Equipment,
Filters, Shielded Rooms
4337 N. 5th Street, Philadelphia 40, Pa.
GLadstone 5-5353

ELK ELECTRONIC LABORATORIES, INC.

Jack Rosenbaum

Specializing in design and development of Test Equipment for the communications radar and allied fields

333 West 52nd St., New York 19, PL-7-0520

F-R MACHINE WORKS

ELECTRONICS — FXR — X-RAY DIVISION

DESIGN - DEVELOPMENT - MANUFACTURE

44-14 Astoria Boulevard Long Island City 3, N.Y.
Phone AStoria 8-2800

HARRIS GALLAY

Electronic Consultant

Military Electronics Since 1935

Your inquiries solicited and our experience is at your command.

60 Perry Street Belleville 9, N.J.
Plymouth 9-4237

PAUL GODLEY CO.

Consulting Radio Engineers

P.O. Box J. Upper Montclair, N.J.
Offs & Lab.: Great Notch, N.J.
Phone: Montclair 3-3000
Established 1926

HERMAN LEWIS GORDON

Registered Patent Attorney

Patent Investigations and Opinions

Warner Building
Washington 4, D.C.
National 2497

100 Normandy Drive
Silver Spring, Md.
Shepherd 2433

HIGHLAND ENGINEERING CO.

William R. Spittal & Staff

Design, Development and Manufacture of Transformers, Chokes, Etc. for the Electronic, Industrial and Allied Fields

Main & Urban, Westbury, L.I., N.Y.
WE-7-2933

HOGAN LABORATORIES, INC.

John V. L. Hogan, Pres.
APPLIED RESEARCH, DEVELOPMENT, ENGINEERING

Est. 1929. Electronics, Optics, Mechanisms, Facsimile Communication, Digital Computers, Electro-sensitive recording media, Instrumentation.

155 Perry Street, New York 14 CHelsea 2-7855

LEONARD R. KAHN

Consultant in Communications and Electronics

Single-Sideband and Frequency-Shift Systems
Diversity Reception - Modulation Theory
Applications of Magnetic Tape Recording

Elizabeth Bldg., 22 Pine St., Freeport, L.I., N.Y.
Freeport 9-8800

DAVID C. KALBFELL, Ph.D.

KAY-LAB Electronic Instruments
Laboratory and Manufacturing Facilities
Specializing in Electronic
Instrumental and Industrial Problems
1090 Morena Blvd. Woodcrest 6359
San Diego 10, California

MEASUREMENTS CORP.

RESEARCH & MANUFACTURING ENGINEERS

Harry W. Houck Jerry B. Minter
John M. van Beuren

Specialists in the Design and Development of Electronic Test Instruments
BOONTON, N.J.

MICROWAVE SERVICES, INC.

"Architects of Modern Communications"

CONSULTANTS, ENGINEERS, CONSTRUCTORS

Wire, Carrier, Radio—Inside and Outside Plant Facilities

S. K. Wolf, E. Labin, V. J. Nexon, and Associates

45 Rockfeller Plaza, New York 20 Circle 7-4953

L. J. CASTRIOTA M. WIND
S. W. ROSENTHAL P. G. MARIOTTI

Microwave Consultants

Radio Frequency and Microwave Components

Telephone
BOulevard 3-2096

G.P.O. Box 844
Brooklyn 1, N.Y.

PICKARD AND BURNS, INC.

Consulting Electronic Engineers

Analysis and Evaluation of Radio Systems

Research, Development, Design and Production of Special Electronic Equipment and Antennas.

240 Highland Ave. Needham 94, Mass.

PSC APPLIED RESEARCH LTD.

Development & Production

AIRCRAFT and INDUSTRIAL
INSTRUMENTS • AIDS • SYSTEMS
Navigation - Survey - Processing - Servo
Gyro - Photo - Magnetic - Electronic
Radiation - Optical
J. M. Bridgman, General Manager
1450 O'Connor Drive Toronto, Canada

PAUL ROSENBERG ASSOCIATES

Consulting Physicists

100 STEVENS AVE. • MOUNT VERNON, NEW YORK

CABLE: PHYSICIST MOunt vernon 7-8040

TELECHROME, INC.

Electronic Design Specialists

COLOR TELEVISION EQUIPMENT

Flying Spot Scanners, Color Synthesizers, Keyers, Monitors, Oscilloscopes and Related Apparatus

J. R. Popkin-Clurman, Pres. & Ch. Engr.
88 Merrick Rd. Amityville, L.I., N.Y.

TELREX, INC.

M. D. Ercolino, Pres.
H. F. ANTENNA SPECIALISTS
Communication Arrays
Reception or Transmission
For FM, TV, and Amateur Service.
Asbury Park, N.J.—Phone AP 2-7252

HARRIS A. THOMPSON

Microwave Electronic Radar
Electro-Mechanical

Consulting
Manufacturing and Development Problems

2525 Pennsylvania, Boulder, Colorado
Phone 1202-W

WHEELER LABORATORIES, INC.

Radio and Electronics

Consulting — Research — Development
R-F Circuits — Lines — Antennas
Microwave Components — Test Equipment
Harold A. Wheeler and Engineering Staff
Great Neck, N.Y. Great Neck 2-7806

INDEX AND DISPLAY ADVERTISERS

Meetings with Exhibits 2A
News-New Products 12A
Membership Meetings 30A
Industrial Engineering Notes 66A
Section Meetings 78A
Student Branch Meetings 88A
Positions Open 128A
Positions Wanted by Armed Forces Veterans 138A

DISPLAY ADVERTISERS

A'G'A (Div. Elastic Stop Nut Corp.) 98A
Ace Engineering & Mach. Co. 97A
Acme Electric Corp. 148A
Aerovox Corp. 39A
Aircraft Radio Corp. 123A
Aircraft-Marine Products, Inc. 55A
Aircraft Transformer Corp. 67A
Airtron, Inc. 90A
Alden Products Company ....58A & 59A
Allen-Bradley Company 89A
Allied Radio Corp. 122A
American Electric Motors 82A
American Lava Corporation 113A
American Phenolic Corp. ....30A & 31A
Amperex Electronic Corp. 151A
Amperite Company, Inc. 68A
Ampex Electric Corp. 34A
Andrew Corporation 94A
Arnold Engineering Co. 60A

Ballantine Laboratories, Inc. 121A
Barber Labs., (Alfred W.) 158A
Barker & Williamson, Inc. 88A
Bell Aircraft Corp. ....134A & 141A
Bell Telephone Labs. 4A
Bendix Aviation Corp. (Eclipse-Pioneer Div.) ..48A
Bendix Aviation Corp. (Friez Instr. Div.) 116A

What to SEE at the Radio Engineering Show

March
23-26
1953

at Grand Central Palace, New York

405 Radio Electronic Exhibits

Firm — Booth

Ace Engineering & Machine Co., Inc., Philadelphia 40, Pa. 3-204 & 205
ACE cell type shielded enclosure and auxiliaries.

Aerovox Corporation
New Bedford, Mass.
Booth 1-602 & 604

Ceramin Capacitors, wire wound resistors choke coils trimmers.

Aircraft-Marine Products, Inc.
Harrisburg, Pa.
Booth 4-502
PLUGS
OILFILLED AND PLASTIC

Insulated capacitors. AN Standard and Multiple circuit connectors. Rivet or Stud and wire end terminals.

Aircraft Transformer Corp.
Long Branch, N.J.
Booth 4-213

Transformers for electronic application in military and high quality commercial equipment. Featuring new and revolutionary coatings for high and low temperature environments. Transformers for missiles, radar, supersonics, communications, test equipment, computers, etc.

Air-Marine Motors, Inc.
Seaford, L.I., N.Y.
Booth 4-315

Sub-fractional hp electric motors, fans and blowers for operation on 60, 400 cps and variable frequencies.

Firm — Booth

Airpax Products Co., Baltimore 20, Md. 4-212
Choppers, vibrators, power supplies.

Airtron, Inc.
Linden, N.J.
Booth 3-102

Flexible waveguides, rigid waveguides, duplexers, tapered flexible waveguides, waveguide bends, crystal mixers, directional couplers, waveguide switches.

Alden Products Co.
Brockton 64, Mass.
Booth 2-143

Alden will show how leaders in the fields of Computers, Business Equipment and Electronic Controls have designed for 30 second servicing, maintenance and operation by unskilled personnel through use of Alden Basic Components, including Terminal Card Mounting System, Basic Chassis, Plug-in Packages, Sensing and Indicating devices, Pre-wired Connectors and Unit Cables.

Alden Electr. & Impulse Recording Equipment Co.
Westboro, Mass.
Booth 2-144

Recorders.

Alfax Paper & Engineering Co., Westboro, Mass. 2-145
Electrosensitive recording papers.

All gheny Ludlum Steel Corp., Pittsburgh 22, Pa. 1-406& & 408
Magnetic Materials.

Allied Control Co., Inc., New York 21, N.Y. 2-209
Electrical Relays and Electrical coils.

Alpha Metals, Inc., Jersey City, N.J. 3-512
Non-ferrous, excluding copper, and powdered metals. Solder: acid core, fluxes, plain, pre-forms, rosin core.

Alpha Wire Corp., New York 13, N.Y. 4-604
Electronic Wire and Cable. Government Specification and commercial types for Rado—Sound—Aircraft—Radar—Television.

Firm — Booth

Altec Lansing Corp., New York 13, N.Y. 3-317
Exhibit a complete line of speech input equipment for radio and TV, featuring our newly designed 230B Control Console for small stations and 250A Control Console for large stations, along with Plug-In Pre-Amplifiers. Line Amplifiers. Monitor Amplifiers and Power Supplies for special fabrication. New High Fidelity speakers having a guaranteed response from 30 to 22,000 cycles as well as the new "20-20 Plus" line of Peerless transformers will also be featured.

American Electric Motors, Inc., Los Angeles 22, Calif. 4-717
A complete display of Miniaturized Motor-driven Fans and Blowers, and variable Frequency Drive Motors utilizing a minimum of eighty different laminations to give maxmum ratings in the smallest frame size. Also samples of high frequency ground Power Supplies of the non-slip ring, maintenance-free inductor design are displayed.

ALSIMAG®
BOOTH 1-606
Custom Made Technical Ceramics

Engineers in attendance to advise on special electronic applications.

AMERICAN LAVA CORPORATION
Chattanooga 5, Tennessee

BRANCHES IN PRINCIPAL CITIES

American Phenolic Corp.
Chicago 50, Ill.
Booths 1-101 & 102

Amphenol is presenting a 40 page manual of "OK Methods" for assembly of all types of connectors to all types of cable and wire.

AMPHENOL

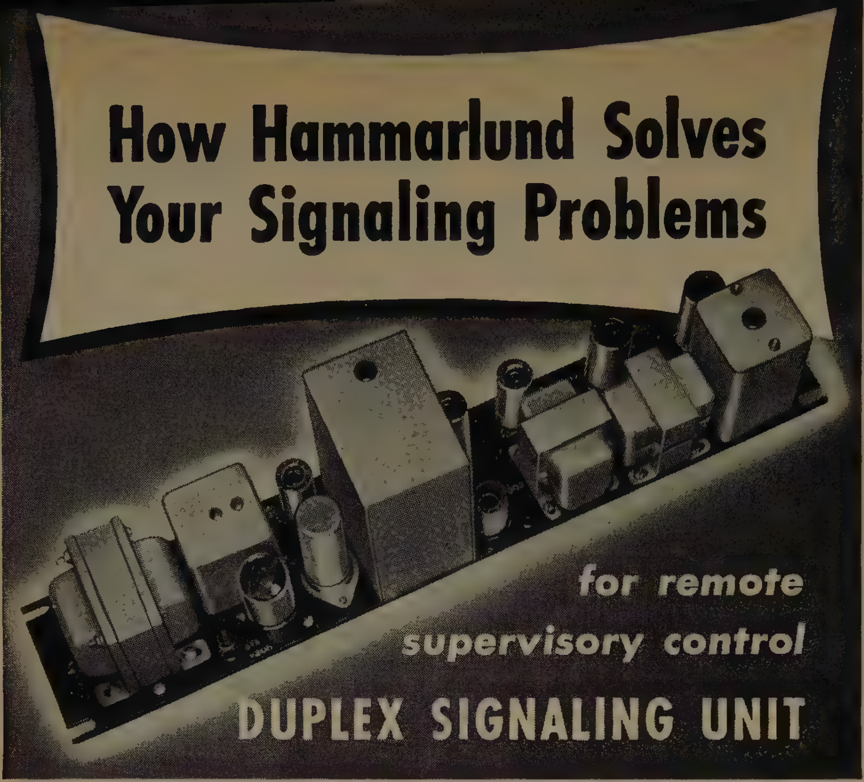
American Radio Hardware Co., Inc., Mount Vernon, N.Y. 4-701
Radio Hardware parts.

American Television & Radio Co.
St. Paul 1, Minn.
Booth 2-304

ATR Vibrators, ATR DC-AC Inverters, ATR Vibrator Power Supplies, ATR Rectifier Power Supplies.

(Continued on page 12A)

Proceedings of the I.R.E. March, 1953, Vol. 41, No. 3. Published monthly by the Institute of Radio Engineers, Inc., at 1 East 79 Street, New York 21, N.Y. Price per copy: members of the Institute of Radio Engineers $1.00; non-members $2.25. Yearly subscription price: to members $9.00; to non-members in United States, Canada and U.S. Possessions $18.00; to non-members in foreign countries $19.00. Entered as second class matter, October 26, 1927, at the post office at Menasha, Wisconsin, under the act of March 3, 1879. Acceptance for mailing at a special rate of postage is provided for in the act of February 28, 1925, embodied in Paragraph 4, Section 412, P. L. and R., authorized October 26, 1927.



How Hammarlund Solves Your Signaling Problems

for remote supervisory control

DUPLEX SIGNALING UNIT

VERSATILITY

This small, compact unit—transmitter, frequency selective receiver and power supply in a single package—is a vastly improved, new approach to remote signaling and supervisory control system design. It may be used for remote on-off switching, continuous supervisory indication of operating conditions, ringdown signaling, dialing terminal equipment, automatic detection of system functional failures, or for providing channels for transmitting and receiving telemetering information.

FLEXIBILITY

These Hammarlund Duplex Signaling Units have the flexibility required for efficient system design. Up to 36 individual functions can be controlled over a single circuit when they are installed in multiple. Transmitters and receivers operate on the same or different frequencies between 2000 and 6475 cycles per second. Center frequencies in the 2000 to 3500-cycle range are spaced at 100-cycle intervals. And center frequencies in the 3625 to 6475-cycle range are spaced at 150-cycle intervals.

RELIABILITY

Ruggedized, quality-recognized components throughout. A highly stable tone generator, and an amplifier designed for bridging a 600-ohm circuit, assure reliable operation over wire lines, telephone or power line carrier, and radio or microwave communications circuits. It is designed to operate in the range of —30° to +60° C. with excellent frequency stability, and under high humidity and other adverse conditions. Harmonic distortion is negligible.

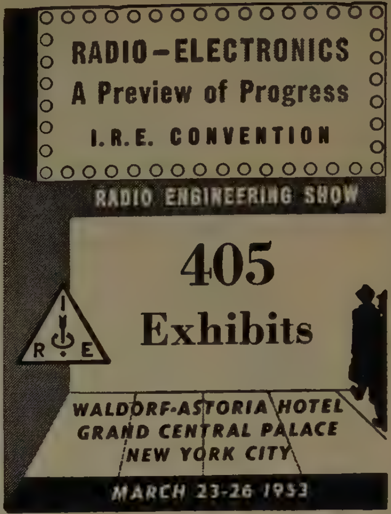
Write for detailed information

HAMMARLUND

HAMMARLUND MANUFACTURING CO., INC.
460 WEST 34th ST. • NEW YORK 1, N. Y.

Visit our booth 4-214 at the I.R.E. Show

Meetings with Exhibits



RADIO—ELECTRONICS
A Preview of Progress
I.R.E. CONVENTION
RADIO ENGINEERING SHOW

405 Exhibits

WALDORF-ASTORIA HOTEL
GRAND CENTRAL PALACE
NEW YORK CITY
MARCH 23-26 1953

△

March 23, 24, 25 & 26, 1953
Radio Engineering Show Grand Central Palace, New York City
Exhibits Manager: Wm. C. Copp, 303 W. 42nd St., New York 36, N.Y.

△

April 11, 1953
NEREM—New England Radio Engineering Meeting, University of Connecticut, Storrs, Conn.
Exhibits: H. W. Sundius, The Southern New England Tel. Co., 227 Church St., New Haven, Conn.

△

April 18, 1953
Spring Technical Conference of the Cincinnati Section, Cincinnati, Ohio
Exhibits: R. H. Lehman, The Baldwin Co., 1801 Gilbert Ave., Cincinnati 2, Ohio

△

May 11, 12 & 13, 1953
National Conference on Airborne Electronics Hotel Biltmore, Dayton, Ohio.
Exhibits: Paul Clark, 120 West Second St., Dayton 2, Ohio.

△

August 19, 20, 21, 1953
1953 Western Electronics Show and Convention, Civic Auditorium, San Francisco, Calif.
Exhibits: Heckert Parker, 1355 Market St., San Francisco 3, Calif.

△

September 21-25, 1953
Eighth National Instrument Conference and Exhibit. Hotel Sherman, Chicago, Ill.
Exhibits: Richard Rimbach, 921 Ridge Ave., Pittsburgh 12, Pa.

△

September 28, 29 & 30, 1953
National Electronic Conference Hotel Sherman, Chicago.
Exhibits: Orville Thompson, c/o DeForrest's Training Inc., 2735 N. Ashland Ave., Chicago 14, Ill.

Industrial Engineering Notes[1]

British Radio Parts Show

The tenth annual private exhibition of British components, tubes, and test gear for the radio, electronic, and telecommunications industries is scheduled to be held in the Great Hall, Grosvenor House, Park Lane, London, on April 14–16, 1953. Over 100 firms will participate in the exhibition which is designed to acquaint manufacturers and engineers with the latest advances in the design and development of British radio, electronic and telecommunications components, tubes, and test instruments.

Audio Fair and Exhibition Slated

The Audio Fair in Chicago, Ill., will be combined with the 1953 International Sight and Sound Exposition to be held at the Palmer House, September 1–3, 1953.

The combined International Sight and Sound Exposition and Audio Fair, the only public high-fidelity audio-video show to be held in the midwest in 1953, is expected to attract more than 20,000 persons during its three-day public and trade display of leading American and foreign equipment.

Sprague Named Under Secretary

R. C. Sprague, formerly chairman of the board of directors and president of RTMA and long a leader in the electronics industry, has been chosen as Under Secretary of the Air Force in the Eisenhower Administration.

Mr. Sprague succeeds R. L. Gilpatric and will serve under Secretary of the Air Force, H. E. Talbott. Both appointments were subject to Senate confirmation.

As Under Secretary of the Air Force, Mr. Sprague is in a highly important position in the Department of Defense and is the outstanding authority on electronics production for the Armed Services among the top civilian administrators of the Defense Department.

It is understood Mr. Sprague reorganized the Sprague Electric Company, of which he was founder and president, in order to accept the governmental appointment, and he has resigned as an RTMA director to free himself of all organized industry affiliations.

Technical and Research News

The Civil Aeronautics Administration has announced the release of a study on its newest air navigation device—the Distance Measuring Equipment (DME). The equipment works on principles somewhat similar to radar, and some 400 DME ground stations, called transponders, now are being installed by the CAA along the airways. The CAA study, called "DME at Work" is available from the CAA, and will be distributed to persons with a direct interest in the operational and engineering features of DME. The study de-

(Continued on page 78)

---

[1] The data on which these Notes are based were selected by permission from *Industry Reports*, issues of December 31, 1952, January 9, January 16, January 23, 1953, published by the Radio-Television Manufacturers Association, whose co-operation is gratefully acknowledged.

The meters illustrated represent only the wide variety of Simpson panel meters and do not constitute the complete line—largest available from any single source. For complete listings, data and prices write *Simpson Electric Company*, 5200 West Kinzie, Chicago 44. For laboratory use and small quantities see your Jobber.

In Canada: Bach-Simpson, Ltd., London, Ont.

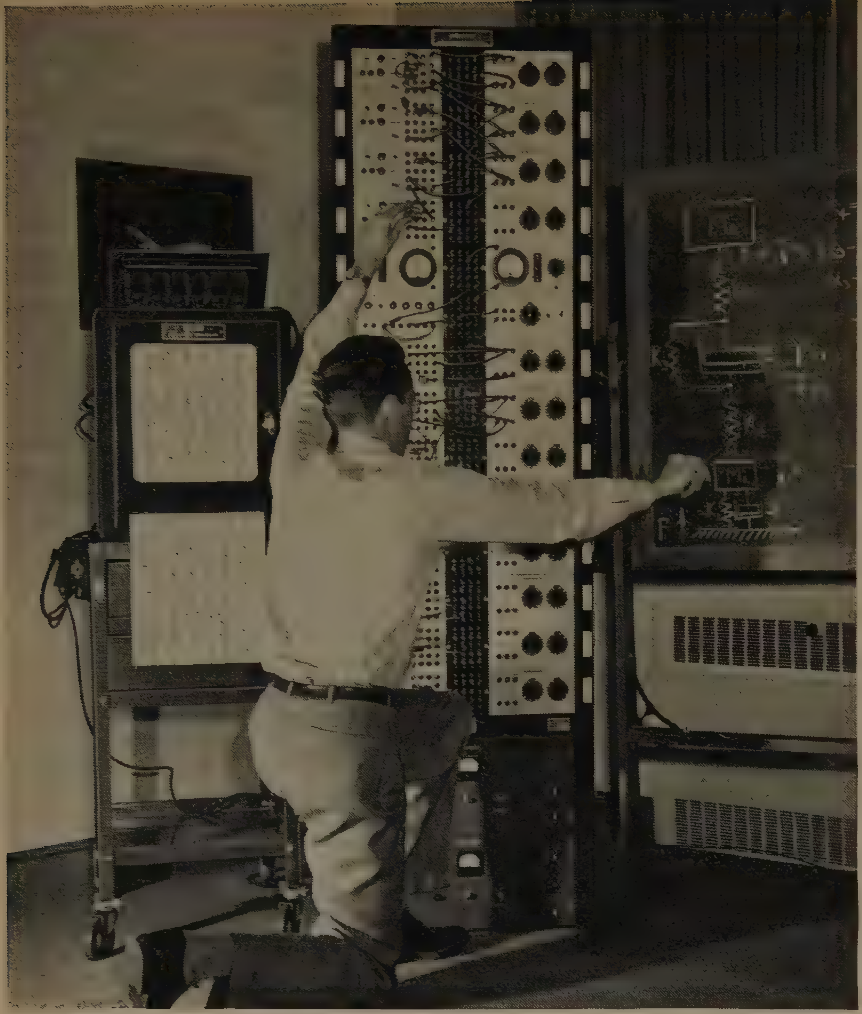
a dozen reasons why

Simpson METERS

are known the world over

Accuracy keeps the wheels
of Industry turning—makes Simpson
the world's largest instrument manufacturer.

BURTON BROWNE ADVERTISING



RECORDS 6 VARIABLES AT ONCE

with Brush Oscillograph

THIS Electronic Analog Computer, developed and manufactured by the Boeing Airplane Company, permits engineers to explore problems in all their variations at one time. Hours of laborious calculations are eliminated.

With the use of the Brush six-channel Oscillograph, results from as many as six different computations are recorded simultaneously. Plotting of results is not necessary, since the Brush Oscillograph provides permanent chart records—immediately! Boeing uses Brush Recorders extensively in their analog computer activities and indicates that their experience with this equipment has been very satisfactory.

Investigate Brush Recording Analyzers for your studies . . . in the laboratory, on the test floor, in the field. Expert technical assistance from Brush representatives located throughout the U.S. In Canada: A. C. Wickman, Limited, Toronto. For bulletin write Brush Electronics Company, Dept. F-3, 3405 Perkins Ave., Cleveland 14, Ohio.

Visit Brush Booth 1-810 at I.R.E. Show

BRUSH ELECTRONICS COMPANY

ELECTRONIC INSTRUMENTS FOR INDUSTRY
PIEZOELECTRIC MATERIALS • ACOUSTIC DEVICES
ULTRASONIC EQUIPMENT • TAPE RECORDERS
RECORDING EQUIPMENT

formerly
The Brush Development Co.
Brush Electronics Company
is an operating unit of
Clevite Corporation

Industrial Engineering Notes

(Continued from page 77A)

scribes a series of flight tests and demonstrations which show the advantages DME offers to airline operators, military aviation, executive pilots and others. . . . **Increased accuracy in an analogue computer for the Laplacian equation has been produced by the National Bureau of Standards.** The electrolytic tank used in most analogue computers for the Laplacian equation, has been replaced in the NBS device by a fine network of resistors. Built under the direction of L. Marton of the NBS Electron Physics Laboratory, the new resistance analogue computer is patterned after a unit developed by G. Liebman, but the accuracy of the device reportedly has been increased by improvements and modifications of the original design. Details on the resistance network analogue computer appeared in the NBS Technical News Bulletin for February, 1953. . . . **An improved type of short-wave antenna is described in a government research report** made available by the Office of Technical Services, U. S. Department of Commerce. The new type antenna contains a coaxial cable in which the inside central rod is made to extend beyond the outside cylinder which forms an effective "sleeve." OTS says the antenna arrangement is simple and rugged and is structurally more desirable than the widely-used, conventional dipole arrangement. The report, PB 107274, "The Sleeve Antenna," is available from the Library of Congress on microfilm at $5.75 and photostat, $18.75. Orders should be addressed to Library of Congress, Photoduplication Service, Publication Board Project, Washington 25, D. C. . . . The OTS also has released a **research report on ways to build electronic aircraft equipment so as to eliminate operational disturbances.** The report is based on the findings of an Air Force survey of sources of interference and static and the techniques for suppressing these disturbances. It is designed as a guidebook, for both electronic equipment and aircraft builders. Copies of the report, PB 111051, "Design Techniques for Interference-Free Operation of Airborne Electronic Equipment," may be obtained in mimeograph for $11.50. Orders should be addressed to the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C.

FCC ACTIONS

The Federal Communications Commission has **finalized, with certain changes, its proposed rule making of April 17, 1952, with respect to Part 12, Rules Governing the Amateur Radio Service,** so as (1) to provide for use of radiotelephone emissions in the 72–7,300-kc segment of the 7-mc amateur frequency band, (2) to enable Novice Class amateur operators to use the 7,175–7,200-kc portion of the 7-mc amateur bands, (3) to establish standards for amateur radio teleprinter operation, (4) to open up the nonradiotelephone segments of the 3.5, 7, and 14-mc amateur bands to F-1 (frequency-shift telegraphy) emission

(Continued on page 79A)

Industrial Engineering Notes

(Continued from page 78A)

and (5) to clarify requirements for the transmission of amateur call signs, including teleprinter operation. The changes were effective February 20, 1953. By separate Report and Order, the Commission finalized its proposal of April 17, 1952, amending Part 12 to permit the General and Conditional Class of amateur operators the use of the bands 3,800–4,000 kc and 14,200–14,300 kc for radiotelephone emissions, effective February 18, 1953. . . . **The FCC has amended Sections 8.104 and 8.105 of its rules regarding certain frequencies in the Maritime Mobile Service.** The amendments were effective February 16, 1953. The requirements of Section 8.104 concern the rapidity of changing from one operating channel to another during transmission or reception by ship stations using telegraphy in the band 2,065 to 2,107 kc, and on specific frequencies in the bands between 4,000 and 23,000 kc, authorized by international agreement. In addition, the FCC amended the section to indicate more precisely the band of frequencies affected by the rule. Copies of the amendments (Mimeograph No. 84766) may be obtained from the Office of Information, Federal Communications Commission, Washington 25, D. C. . . . The eighteenth **Annual Report of the Federal Communications Commission covering the fiscal year 1952, which ended June 30, shows that the number of radio authorizations issued passed the one million mark for the first time during the year.** The Annual Report was submitted to Congress by chairman P. A. Walker. The FCC report pointed out that there now are 45 times more nonbroadcast stations than there are broadcast stations. In other words, more than 200,000 radio authorizations are held by public agencies and by private industry and individuals as compared with less than 5,000 stations engaged in program broadcasting. The broadcast figure includes about 1,200 pickup and studio-transmitter links. The nonbroadcast figures, on the other hand, do not indicate the actual number of transmitters involved, since a single authorization—as in the case of a police or fire department, railroad, taxicab company, etc.—can cover many portable or mobile transmitters. Most of the nonbroadcast radio stations are grouped in the Safety and Special Radio Services. Their more than 212,000 authorizations represent the use of nearly 540,000 transmitters and constitute the largest number of radio stations licensed by the Commission. The safety group, with nearly 80,000 authorizations, covers the use of nearly 190,000 transmitters in the following fields: Aeronautical (42,000 transmitters), Marine (35,000), Police (81,000), Fire (11,000), Forestry-Conservation (14,000), Highway Maintenance (4,200), Special Emergency (1,900), and State Guard (140). The industrial group, with nearly 14,000 authorizations, covers the use of more than 90,000 transmitters by the Power (51,000),

(Continued on page 86A)

THE SIMPSON MODEL 260 VOLT-OHM-MILLIAMMETER

outsells all others combined because . . .

A covers all ranges necessary for Radio and TV set testing
B includes the Simpson 50 Microampere Meter Movement known the world over for its ruggedness
C no bulky harness wiring, thus eliminating all intercircuit leakage at this high sensitivity
D molded recesses for resistors, batteries, etc.
E easy battery replacement
- all components—including case and panels—are specially designed and completely tooled for maximum utility . . . not merely assembled from stock parts

ranges *20,000 Ohms per Volt DC,*
1,000 Ohms per Volt AC
Volts, AC and DC: 2.5, 10, 50, 250, 1000, 5000
Output: 2.5, 10, 50, 250, 1000
Milliamperes, DC: 10, 100, 500
Microamperes, DC: 100
Amperes, DC: 10
Decibels (5 ranges): −12 to +55 DB
Ohms: 0-2000 (12 ohms center), 0-200,000 (1200 ohms center), 0-20 megohms (120,000 ohms center)

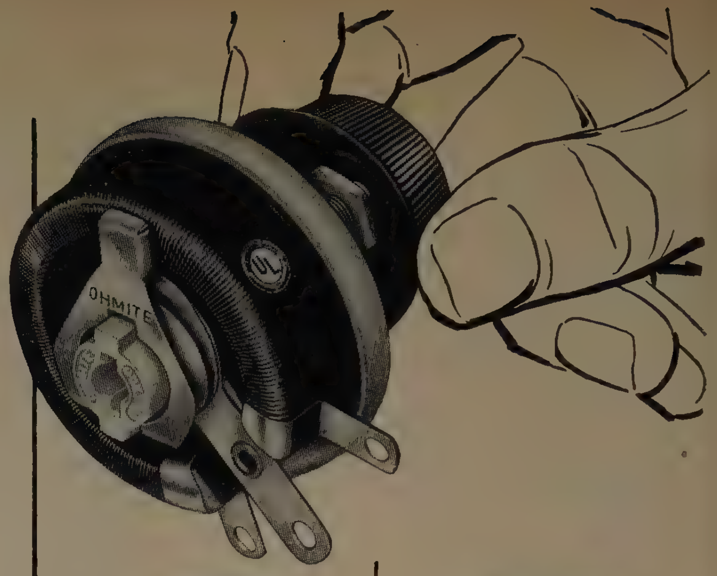
SIMPSON ELECTRIC COMPANY
5200 W. Kinzie St., Chicago 44 Phone COlumbus 1-1221
In Canada: Bach-Simpson, Ltd., London, Ont.

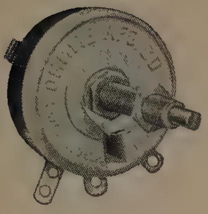
prices
Model 260 $38.95; With Roll Top $46.90. Complete with test leads and operator's manual. 25,000 volt DC Probe for use with Model 260, $9.95.

BURTON BROWNE ADVERTISING

OHMITE® *RHEOSTATS*

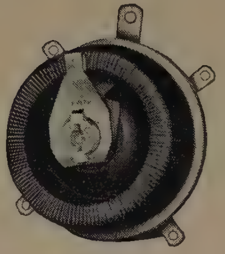
WITH SPECIAL FEATURES . . .





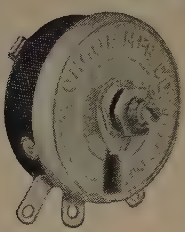
BUSHINGS FOR SPECIAL PANEL THICKNESS

Extra-long bushings and shafts for mounting on panels up to 2" thick.



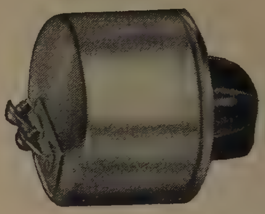
360° WINDING

Available with continuous circular core and endless winding.



SCREW DRIVER SLOT SHAFT

Shaft ends slotted for occasional adjustments with a screw driver.

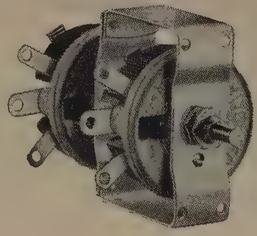


SEALED, ENCLOSED CAGES

Compact, corrosion-resistant metal cages, sealed by a double seam.

SNAP-ACTION OFF POSITION

Opens at high or low resistance position. Notch provides indexing.

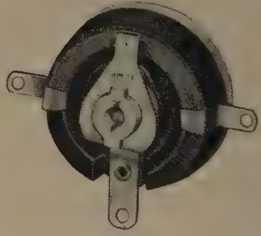


TANDEM ASSEMBLIES

Two or more rheostats in tandem for simultaneous operation.

TOGGLE SWITCH

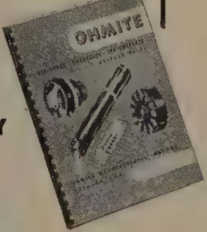
Switch is operated with a positive snap by movement of the contact arm.



LESS THAN STANDARD ROTATION

Has winding space and angle of rotation less than standard.

- In addition to a complete line of standard rheostats, OHMITE manufactures a wide variety of rheostats with special features. All have the distinctive OHMITE design qualities: smoothly gliding metal-graphite brush; all-ceramic construction; insulated shaft and mounting; windings permanently locked in place by vitreous enamel. Specify OHMITE for your special-feature rheostats, and know you'll get the best!



Write on Company Letterhead for Catalog and Engineering Manual No. 40.

OHMITE MANUFACTURING COMPANY
4862 Flournoy Street, Chicago 44, Illinois

OHMITE

first IN WIRE-WOUND RHEOSTATS AND RESISTORS

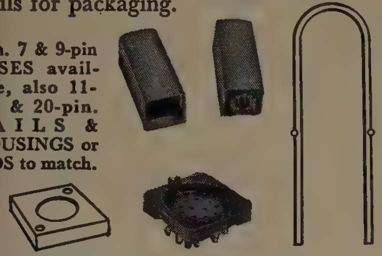
READY-MADE for your Electronic Equipment

All designed — all tooled — production immediately available — no procurement problems. *Apply ALDEN Standards wholly or in part.*

ALDEN PLUG-IN PACKAGES

4th After mounting your circuits on Terminal Cards, use Alden Standard Plug-in Bases, Housings, Bails for packaging.

Min. 7 & 9-pin BASES available, also 11-pin & 20-pin. BAILS & HOUSINGS or LIDS to match.

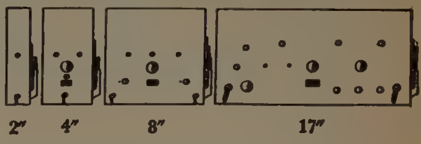


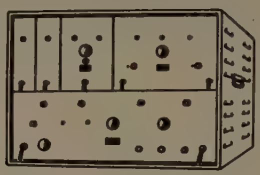
ALDEN PLUG-IN PACKAGES

Using standard Alden Plug-in Packaging Components you can mount a tremendous variety of circuits on chassis or in racks.

Alden "20" Rack Mounting Socket with extended ears that mount side by side and in multiple rows on U-Channels that accommodate 50 Alden "20" Plug-in Units illustrated, in 10½ x 19" rack mounting panel.

HOUSE PLUG-IN UNITS IN ALDEN BASIC UNI-RACKS

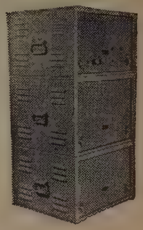




FOUR SIZES OF CHASSIS MOUNT IN ANY COMBINATION IN ALDEN UNI-RACKS

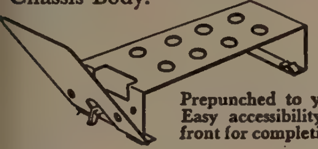
STACKED

Mounting all equipment in Alden Uni-Racks provides a uniform system easy to handle and ship. Can be installed and interconnected as fast as unloaded.

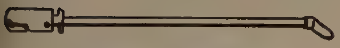


ALDEN BASIC CHASSIS

4th Fit Prepunched Cards carrying completed circuitry into Standard Alden Basic Chassis Body.



Prepunched to your specs. Easy accessibility at sides, front for completing wiring.



SERV-A-UNIT LOCK

pulls in or ejects chassis.

SLIDE-IN BACK CONNECTORS

See description on opposite page.

ALDEN BASIC CHASSIS

with spares provides 30-second servicing for your unitized circuitry.

ALDEN UNIT CABLE

interconnects between Uni-racks or other major circuitry divisions. Quick, sure, coded means of isolating and restoring (with spare) inter-division circuits.

SEND FOR FREE "ALDEN HANDBOOK"

Your design and production men have always wanted these advantages:

1. Experimental circuitry can be set up with production components, cutting down debugging time.
2. Allows technicians, rather than engineer, to debug, by taking out unit.
3. Given the circuitry, nothing further to design—make up from standard Alden components.
4. Optimum circuit layout using standard terminal card.
5. Absolute minimum requirements of labor, materials, space.
6. The various sub-assemblies can be built concurrently on separate assembly lines.
7. No tooling costs—no delays—no procurement headaches.
8. Fewer prints—smaller parts inventory.
9. Can subcontract assemblies.

Your customers and sales force will welcome these advantages:

The big objection to electronic equipment—from the user's point of view—is that if it goes out of order he feels helpless. But you have a perfect answer when your equipment is made to Alden Standards of Plug-in Unit Construction because they assure DEPENDABLE OPERATION, as follows—

30-SECOND REPLACEMENT OF INOPERATIVE UNITS by plugging in available coded spares.

TROUBLE INSTANTLY INDICATED AND LOCATED by monitoring elements assigned to each functional unit.

TECHNICAL PERSONNEL NOT REQUIRED to maintain in operation, due to obvious color coding and fool-proof non-interchangeability of mating components.

TOOLESS MAINTENANCE made possible by patented Alden fasteners and plug-in locking and ejecting devices.

AIRMAIL SERVICE—
Compact functional units practical to send airmail to factory for needed overhaul.

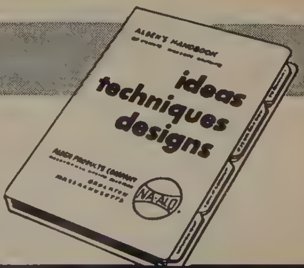
UNI-RACK FIELD HANDLING UNIT—groups functional units into stacking cabinets not exceeding one- or two-man handling capacity—go easily through windows, doors.

CONNECT AS FAST AS UNLOADED, by coded non-interchangeable unit cables plugged in between Uni-racks.

SEND FOR FREE 226-PAGE HANDBOOK

This 226-page Handbook describes fully the Alden System of Plug-in Unit Construction and the hundreds of components ready-made and completely tooled to meet your every requirement. It's a gold-mine for those designing electronic control equipment that is practical in manufacture; dependable in operation.

REQUEST YOUR COPY TODAY — SENT FREE!



Unit shown greatly magnified. Actual sizes from 5/16" to 29/32" dia.

HI-Q®

ceramic disk capacitors

Seven sizes. Capacities of from .3 mmf. to .026 mfd. Ceramic dielectric materials with K factor ranges from 14 to 6000, provide excellent opportunities for diversified applications.* Used for by-passing, blocking, coupling, etc. Sturdily constructed. Precisely tested. Moisture-proofed.

Also available in temperature-compensating, multi-section, stacked units and other types to meet every electronic need.

And backed by highly informative data, such as the Preferred Value Chart here shown, available on request.

*FUNCTION-FITTED: The outstanding application-engineering experience with ceramic dielectric capacitors, is yours for the asking. Let us collaborate for the most economical and satisfactory answer to your requirements.

HI-Q® DIVISION

AEROVOX CORPORATION
OLEAN, N.Y.

AEROVOX CORPORATION
NEW BEDFORD MASS.

WILKOR DIVISION
CLEVELAND, OHIO

Export: 41 E. 42nd St., New York 17, N. Y. • Cable: AEROCAP, N. Y.
• In Canada: AEROVOX CANADA LTD., Hamilton, Ont. JOBBER ADDRESS: 740 Belleville Ave., New Bedford, Mass.

Industrial Engineering Notes

(Continued from page 79A)

Petroleum (15,000), Forest Products (5,200), Special Industrial (15,000), Low-Power Industrial (2,300), Relay Press (nearly 450), Motion Picture (nearly 200), Agriculture (10) and Radiolocation (11) Services. The land-transportation group, with nearly 6,500 authorizations, covers the use of nearly 145,000 transmitters in the field of Railroad (9,000), Urban Transit (1,700), Intercity Bus (400), Taxicab (125,000), Highway Truck (3,200), Automobile Emergency (1,500), and Citizens (3,000). The Amateur Radio Service, the FCC noted, has more than 113,000 authorizations covering about the same number of transmitters. The relatively new Disaster Communications Service has 69 authorizations but more than 400 transmitters. The close of the fiscal year saw 2,420 authorized commercial AM broadcast stations and 582 commercial FM stations. Copies of the FCC Annual Report may be obtained from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C., at 40 cents per copy.

RTMA Activities

Calling on all television manufacturers for co-operation, W. R. G. Baker, director of the RTMA engineering department, has presented **an RTMA plan for implementing and accelerating the reduction of spurious-oscillator radiation in TV transmission and reception,** at an all-industry engineering conference in the Biltmore Hotel, New York City. Dr. Baker appointed three task committees from the RTMA engineering department to carry out the plan in co-operation with the Joint Technical Advisory Committee and the Institute of Radio Engineers. A task committee on receivers, headed by J. A. Chittick, of RCA Division of RCA, will have responsibility for developing technical data on the limitation of oscillator radiation by television receivers and a time-table for carrying out the recommendations. A task committee, headed by J. E. Keister, of General Electric Company, will perform the same functions in the transmitter field. A third task committee, headed by D. G. Fink, of the Philco Corporation, will co-ordinate the work of the other two task committees with JTAC, IRE, and the Federal Communications Commission. This task committee also will have responsibility for disseminating full information on the developments to the industry. President A. D. Plamondon, Jr., and general counsel Glen McDaniel both stressed the importance of prompt industry action to reduce spurious-oscillator radiation and urged complete co-operation of the industry in making effective the plan proposed by Dr. Baker. . . . **Two promotions and a staff addition at RTMA headquarters have been announced by executive vice president J. D. Secrest.** P. H. Cousins, who has been information director of RTMA for several years, has been appointed special assistant to Mr. Secrest and staff

(Continued on page 87A)

Industrial Engineering Notes

(Continued from page 86A)

assistant to the technical products division. Tyler Nourse, who served as assistant information director under Mr. Cousins, has been promoted to the position of editorial director in charge of RTMA publications. H. F. Hodge, Jr., of Silver Spring, Md., formerly in government information service joined the RTMA headquarters staff on January 26, as an editorial assistant to Mr. Nourse. The staff reorganization was effected following the resignation of R. M. Haarlander, who has served as staff assistant to the technical products division for the past five years. Mr. Haarlander resigned to take a position in private industry. . . . Attorney General J. P. McGranery on his last day in office, January 19, **announced that he had revoked the grand jury authorization for a sweeping investigation of the electronics industry.** In January of last year the Department of Justice authorized a widespread probe of the industry, and RTMA and 17 or more radio and television set manufacturers were served subpoenas. "Most of the persons to whom subpoenas were directed have complied substantially with them," Mr. McGranery said. The Attorney General, in halting the inquiry, indicated that the removal of whatever restraints may exist in the industry should more properly be the subject of civil litigation than of criminal prosecution.

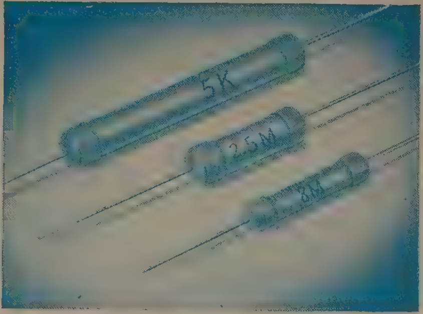
MOBILIZATION NEWS

The Federal Civil Defense Administration has announced that it is working with government experts and the radio manufacturing industry to develop **a small, low-cost, mass-produced radio which will receive civil defense and other emergency information under air-raid alert or bombing attack if the regular power supply fails.** The proposed radio receiver may be independently powered by batteries, or it may be a crystal set, FCDA said. While the emergency set is being developed, the public can rely for emergency information in case of home power failure, on the 27.5 million auto radios and 10 million portable battery sets now in operation. The agency is encouraging the development of a small, inexpensive portable standard "CD Alert" receiver capable of receiving the CONELRAD programs on 640 or 1240 kc. The CONELRAD Plan (Plan for CONtrol of ELectro-magnetic RADiation) permits AM broadcasting stations to remain on the air in civil defense emergencies. . . . **The radiation instrument industry, virtually nonexistent in 1946, had an annual business volume of approximately $20 million and employed more than 2,400 persons in 1952,** according to a survey conducted by the U. S. Atomic Energy Commission. Growth of the new industry has paralleled development of the nation's atomic energy program since early 1947, when the AEC adopted a policy of encouraging its operating contractors to procure radiation instruments from com-

(Continued on page 98A)

Made under Western Electric license agreement, these deposited-carbon resistors serve a real need in laboratory-grade instruments and assemblies. For superlative stability under the most adverse operating conditions, Carbofilm resistors are now available in hermetically-sealed metal casings with glass-to-metal end seals. Thoroughly protected — mechanically, electrically, climatically. Guaranteed tolerance of plus/minus 1%. Available in ½, 1 and 2 watt sizes. Just about everything a precision resistor should be!

Also in the coated (special resin film seal) type for accuracy, stability, economy. Guaranteed tolerance of plus/minus 1%. Excellent characteristics. ½, 1 and 2 watt sizes.



Carbofilm resistors, in both hermetically-sealed and coated types, are available in standard values as well as special values made to your requirements. Literature on request. Let us quote on your *precision resistance* needs.

WILKOR DIVISION
AEROVOX CORPORATION
2882 Detroit Avenue, CLEVELAND, OHIO

AEROVOX CORPORATION NEW BEDFORD MASS.
HI-Q® DIVISION OLEAN, N. Y.
Export: 41 E. 42nd St., New York 17, N. Y. • Cable: AEROCAP, N. Y.
In Canada: AEROVOX CANADA LTD., Hamilton, Ont. JOBBER ADDRESS: 740 Belleville Ave., New Bedford, Mass.

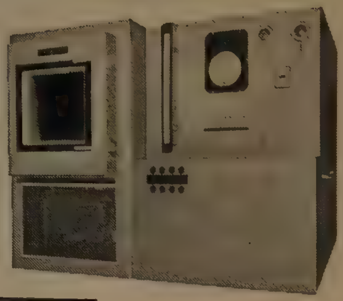
temperatures!
atmospheres!
pressures!

FOR ACCURACY TEST WITH Tenney

. . . For Tenney Test Chambers are precision-engineered for maximum efficiency and can be designed to simulate the complete range of temperature, atmospheric or pressure conditions found anywhere on earth—or above it to altitudes of 120,000 ft. plus! They attain sub-zero temperatures quickly, maintain them efficiently and provide full instrumentation for accurate evaluation of complete test data.

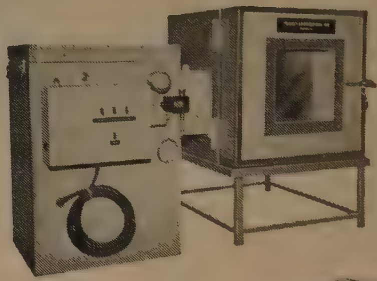
TENNEYZPHERE ALTITUDE CHAMBERS

Designed to withstand atmospheric pressure and to simulate global conditions of pressures, temperatures and humidities. Altitudes from sea level to approx. 80,000 ft. Temperature range from plus 200°F to minus 100°F. Also simulates desired (20% to 95%) relative humidity.



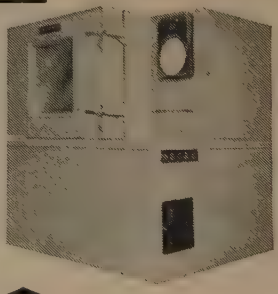
TENNEY SERVO UNIT

Portable air conditioning unit which may easily be attached to various types of laboratory enclosures —impact machines; tension machines; torsion testers; cold boxes and similar equipment. Through its use, articles undergoing testing, aging or weathering can be subjected to wide variations of humidity, heat and cold. Photo shows servo attached to companion chamber.



TENNEY TEMPERATURE AND HUMIDITY CHAMBERS

These chambers provide positive control of wet- and dry-bulb temperatures, humidity, and air circulation; and are designed for research and production testing of physical quality, fragility, tension, and all other pertinent factors, at constant conditions or on planned program cycles.

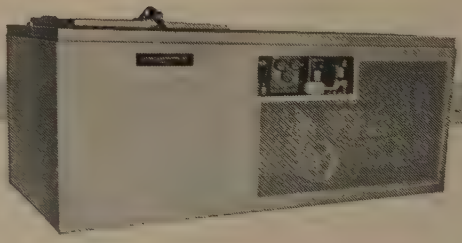


Model TR—Precision recorder controllers permit accurate simulation and check of temperatures to +200°F. Meets all Mil and JAN specifications for low- and high-temperature requirements by incorporation of temperatures down to −100°F. Humidities within 20%-95% range. Built in a variety of standard sizes.

Model TH—Specifically designed for a temperature range of +35°F to +180°F, and a humidity range of 20%-95%. Accurately simulates, controls, and checks all above-freezing temperatures. Can incorporate program control for meeting a wide variety of Mil specifications if desired. Manufactured in many standard sizes.

TENNEY SUB-ARCTIC INDUSTRIAL CABINETS

Designed for low-temperature testing of metals, radios, instruments, plastics, liquids, chemicals and pharmaceuticals. Temperature ranges of −40°F, −60°F, −95°F and −150°F are standard for each size.



Tenney
ENGINEERING, INCORPORATED

Los Angeles Representative: GEORGE THORSON & CO.
Chicago Representative: SPARTAN ENGINEERING CO.

Engineers and Manufacturers
of Automatic Environmental Test Equipment

8670

For further information on these and other Tenney test equipment, write to Tenney Engineering, Inc., Dept. N, 26 Avenue B, Newark 5, New Jersey.

SLANT your requirements to

INSTRUMENT CORP. OF AMERICA

for miniature

SLIP RING AND COMMUTATOR ASSEMBLIES

This Instrument Corporation of America plant contains the most modern and complete facilities available anywhere in the world for the exclusive production of Miniature Slip-Ring and Commutator Assemblies to precision standards. It is now in full scale production to meet your requirements in the fastest possible time at the lowest possible cost.

ALL TYPES OF CONSTRUCTION NOW AVAILABLE INCLUDING MOLDED OR FABRICATED TYPES

Assemblies of these types can be supplied at low cost. Quality is the highest in the industry. Dimensional accuracy and other characteristics are excellent and these units are highly recommended for instruments such as synchros.

ONE PIECE ELECTRO-PLATED TYPES FOR EXTREME ACCURACY

Wherever extreme dimensional precision, accurate concentricity and high dielectric qualities are required, the electro-deposition method is recommended . . . the production of which is licensed under an exclusive arrangement with the Electro Tec Corporation.

TYPICAL SPECIFICATIONS:

Sizes: .035" to 24" Cylindrical or Flat

Cross-sections: .005 to .060" or more

Finish: Polish to 4 Micro-Inches or Better

Breakdown: 1000 V or More Hi-Pot Inter-Circuit

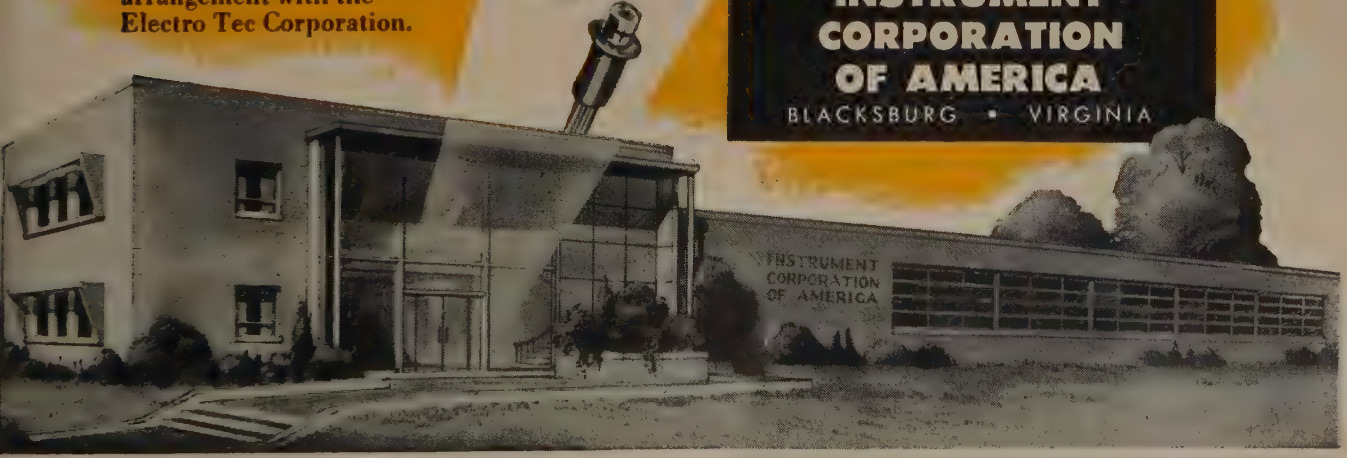
Ring Hardness: 60 to 70 Brinell

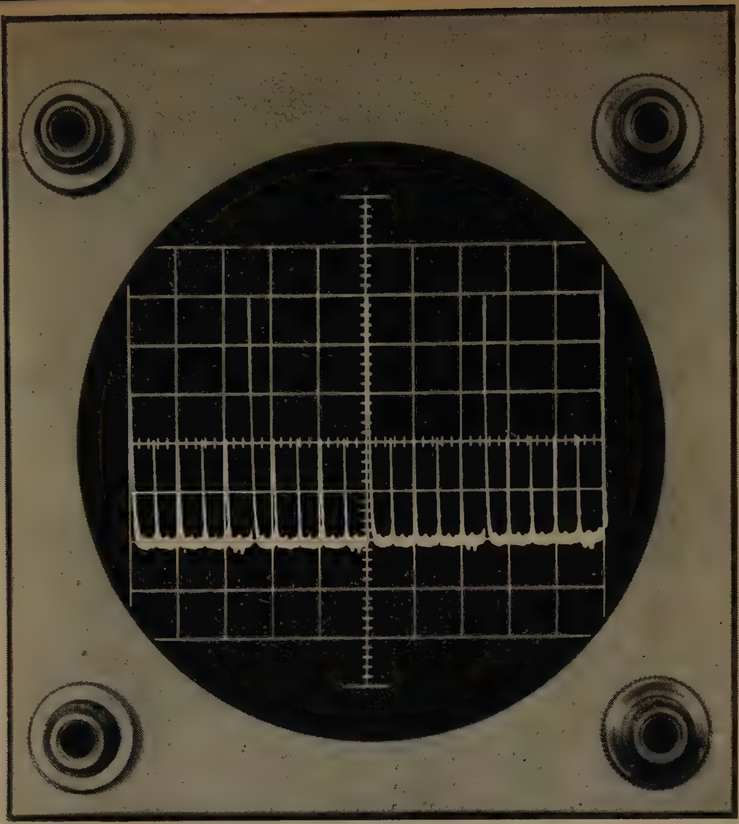
Rotation Speeds: To Over 12000 RPM

Surface Protection: Palladium and Rhodium or Gold Prevent Tarnish, Minimize Wear

Our engineering staff is at your service at all times for consultation

INSTRUMENT CORPORATION OF AMERICA
BLACKSBURG • VIRGINIA





ACCURATELY CALIBRATED
...in both TIME and AMPLITUDE

With the TEKTRONIX Type 315-D you read time intervals and amplitudes directly from the screen. In the actual-size photograph above the time base setting is 20 μsec/division, showing the time interval between the small pips to be 10 μsec; between the large pips, 50 μsec. Vertical sensitivity is set at 0.5 v/division, showing the amplitude of the small pips to be 1 volt, and the amplitude of the large pips to be 2.5 volts.

Twenty-four calibrated time bases: 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50, 100, 200, 500 microseconds/division, 1, 2, 5, 10, 20, 50, 100, 200, 500 milliseconds/division, 1, 2, 5 seconds/division. Calibration accuracy 3% or better except at 0.1, 0.2, 0.5 μsec/div and 1, 2, 5 sec/div where accuracy is within 5%. Uncalibrated time base continuously variable from approximately 0.1 μsec/div to 10 sec/div.

Twelve calibrated vertical sensitivity positions: 0.01, 0.02, 0.05, 0.1, 0.2, 0.5, 1, 2, 5, 10, 20, 50 volts/division. When set on any one position by means of a front panel screwdriver control all other positions will fall within 3% of this accuracy. Choice of ac or dc coupling except in the 3 most sensitive positions. Sensitivity continuously variable but uncalibrated from approximately 0.01 v/div to 100 v/div.

OTHER CHARACTERISTICS OF THE TYPE 315-D

Vertical Bandwidth — dc to 5 mc

Risetime — 0.07 μsec

Voltage Calibrator — square wave, approx. 1 kc

Attenuator Probe — 10x, small, insulated

3″ CRT — high-definition, flat-faced

Graticule — edge lighted, 1/4″ divisions

5x Magnifier — expands time base to right and left of center

Direct Coupled Unblanking

Trigger Amplitude Discriminator

Size — 12 3/8″ high, 8 5/8″ wide, 18 1/4″ deep

Weight — only 36 lbs.

Type 315-D — for use on 50-60 cycle line only — $770

Type 315-D — for use on 50 to 800 cycle power line — $785

PRICES F.O.B. PORTLAND, OREGON

Call or write your TEKTRONIX Field Engineer for a demonstration of the Type 315-D

See and try the Type 315-D and other TEKTRONIX instruments at the March I.R.E. show.

TEKTRONIX, Inc.

P. O. Box 831A, Portland 7, Oregon • Cable: TEKTRONIX

See Us at Booth 2-401, 2-402

Industrial Engineering Notes

(Continued from page 87A)

mercial manufacturers. The survey shows an expanding market for radiation instruments outside of the AEC program as well as within AEC installations. According to the survey, military agencies of the government now provide about 50 per cent of the total market; the AEC and its principal contractors provide about 30 per cent of the total market; and the remainder is accounted for by private industry universities, hospitals and research institutes, civil defense, export, and uranium ore prospecting. The AEC survey is believed to cover more than 90 per cent of the radiation instrument industry in terms of business volume. Seven companies with probable business volume in excess of $1 million each in 1952 account for about 50 per cent of the industry's activity. More than 50 patents in the field of radiation instruments are owned by the government and held by the AEC. A total of 51 nonexclusive, royalty-free licenses have been granted on these patents. Application for such licenses may be made to the Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington, D. C.

NEW TV GRANTS BY FCC

The Federal Communications Commission granted construction permits for 40 new television stations for the period December 31–January 23, including the first in Wyoming. To date, only Vermont and New Hampshire now remain without authorizations or stations. In all, 316 television stations have been authorized by the FCC, 208 since the freeze was lifted and 108 previously operating outlets.

The following new TV construction permits were authorized during the period December 31–January 23:

Altoona, Pa., The Gable Broadcasting Company, Channel 10, 316 kw visual, 160 kw aural

Bakersfield, Calif., Bakersfield Broadcasting Company, Channel 20, 20.5 kw visual, 11 kw aural

Bangor, Maine, Community Telecasting Service, Channel 5, 1.9 kw visual, 0.95 kw aural

Bellingham, Wash., KVOS Inc., Channel 12, 16 kw visual, 8 kw aural

Billings, Mont., Rudman-Hayutin Television Company, Channel 8, 12 kw visual, 6.2 kw aural

Boise, Idaho, Idaho Broadcasting & Television Company, Channel 9, 32 kw visual, 16 kw aural

Boise, Idaho, KIDO Inc., Channel 7, 51 kw visual, 26 kw aural

Buffalo, N. Y., Buffalo-Niagara Television Corporation, Channel 59, 91 kw visual, 51 kw aural

Butte, Mont., Copper Broadcasting Company, Channel 4, 14.5 kw visual, 7.3 kw aural

Cheyenne, Wyo., Frontier Broadcasting Company, Channel 5, 5.2 kw visual, 2.65 kw aural

(Continued on page 101A)

Industrial Engineering Notes

(Continued from page 98A)

Columbia, Mo., The Curators of the U. of Missouri, Channel 8, 205 kw visual, 105 kw aural

Dallas, Tex., UHF Television Company, Channel 23, 220 kw visual, 115 kw aural

Fargo, N. D., WDAY Inc., Channel 6, 7 kw visual, 35 kw aural

Festus, Mo., Ozark Television Corporation, Channel 14, 170 kw visual, 89 kw aural

Great Falls, Mont., Buttrey Broadcast Incorporated, Channel 5, 8.9 kw visual, 4.5 kw aural

Greenville, S. C., Greenville Television Company, Channel 23, 22 kw visual, 11 kw aural

Harrisburg, Pa., Harrisburg Broadcasters Inc., Channel 71, 220 kw visual, 110 kw aural

Jamestown, N. Y., James Broadcasting Company, Incorporated, Channel 58, 100 kw visual, 56 kw aural

Kansas City, Mo., Empire Coil Company, Incorporated, Channel 25, 93 kw visual, 51 kw aural

Kingston, N. Y., Kingston Broadcasting Corporation, Channel 66, 25 kw visual, 13.5 kw aural

Lafayette, Ind., WFAM Incorporated, Channel 59, 20 kw visual, 105 kw aural

Lakeland, Fla., WONN-TV, Incorporated, Channel 16, 85 kw visual, 43 kw aural

Lawton, Okla., Oklahoma Quality Broadcasting Company, Channel 7, 10 kw visual, 5 kw aural

Louisville, Ky., Robert W. Rounsaville, Channel 41, 240 kw visual, 125 kw aural

Meridian, Miss., Mississippi Broadcasting Company, Channel 30, 210 kw visual, 110 kw aural

Muskegon, Mich., Versluis Radio & Television Incorporated, Channel 35, 270 kw visual, 140 kw aural

Neenah, Wis., Neenah-Menasha Broadcasting Company, Channel 42, 15.5 kw visual, 8.3 kw aural

New London, Conn., The Thames Broadcasting Company, Channel 26, 105 kw visual, 54 kw aural

Northampton, Mass., Regional Television Corporation, Channel 36, 21.5 kw visual, 11.5 kw aural

Pittsburgh, Pa., J. Frank Gallaher, Loren Berry, and Ronald B. Woodyard, a Partnership, Channel 47, 230 kw visual, 120 kw aural

Pittsburgh, Pa., Telecasting Company of Pittsburgh, Pa., Channel 16, 89 kw visual, 50 kw aural

Reno, Nev., Nevada Radio-Television Incorporated, Channel 8, 3 kw visual, 1.5 kw aural

Rochester, Minn., Southern Minnesota Broadcasting Company, Channel 10, 105 kw visual, 54 kw aural

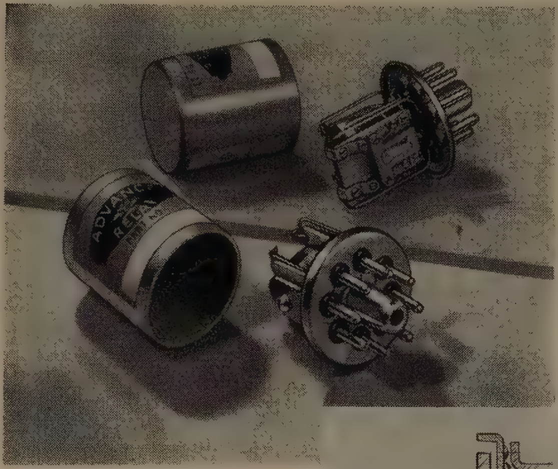
Salinas, Calif., Salinas-Monterey Television Company, Channel 28, 105 kw visual, 60 kw aural

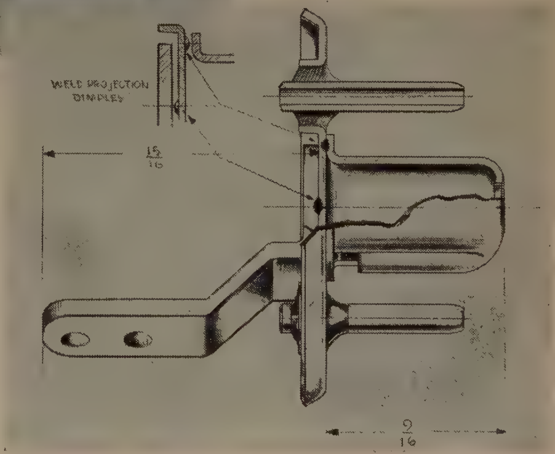
(Continued on page 102A)

Problem:* *The Advance Electric and Relay Co. of Burbank, California....was called upon by the military to produce a hermetically sealed relay to very tight size and weight specifications. This called for eliminating traditional internal bracing.

Solution: A Fusite glass-to-steel plug-in type hermetic terminal played a large part in the design of the Advance "Tiny Mite" Relay. Working in close cooperation, Fusite adapted its standard octal plug-in terminal to a projection welded bracket on which the entire relay mechanism was hung. Thus the terminal became a structural part as well as a seal.

Because of their extreme rugged construction, Fusite terminals are often being called on to do more than conduct electricity in and out of sealed units.





Moral: When you have a problem in hermetic sealing, let the Fusite engineers in on it early in the game. Chances are we can save you time and money in the design of your electrical product.

WRITE for catalog or tell us your needs for actual samples. Dept. B-1.

INSULATE ELECTRICALLY
GLASS TO METAL
FUSITE
TERMINALS
PROTECT PRODUCT PERFORMANCE
SEAL HERMETICALLY

Visit the Fusite Display at Radio Engineering Show
N. Y. C. March 23-26. Booth 3-109.

THE FUSITE CORPORATION
6028 FERNVIEW AVE. CINCINNATI 13, OHIO

Something Special in
ROTARY SWITCHES

- ★ **Single deck, single pole, 36 or 60 positions**
- ★ **Easily Ganged**
- ★ **Large Current Capacity**
- ★ **Non-Shorting with Detent**
- ★ **Isolated Shaft**
- ★ **Four Point Mounting**

Here's the answer to complicated range or circuit switching problems in high quality test equipment or experimental apparatus.

A number of these single deck switches may be ganged to provide additional poles. Both switches have a special detent which also provides the non-shorting action. The rotor arm is actually *lifted* as it moves from one contact to the next. This Shallcross design provides more usable contacts in less space than conventional non-shorting switches. Write for prices and drawings. Shallcross Manufacturing Co., 524 Pusey Ave., Collingdale, Penna.

SPECIFICATIONS

Types 10061-S (60 pos.) and 10054-S (36 pos.)
Shaft Extension: 1" beyond spacers
Size: 4⅞" sq. x 1½" d.
Insulation: Phenolic. Isolated shaft.
Avge. Contact Resistance: 0.006 ohms max.

Type	#10061-S	#10054-S
Voltage Breakdown:	1500 v.	2500 v.
Current Capacities		
Carrying—	30 amps.	40 amps.
Breaking—	2 amps. at 110 v. a-c	3 amps. at 110 v. a-c

Coming to the I.R.E. Show? See us at Booths 2-210 and 2-211

Shallcross

Industrial Engineering Notes

(Continued from page 101A)

Sandusky, Ohio, Lake Erie Broadcasting Company, Channel 42, 18 kw visual, 9.1 kw aural
Santa Fe, N. M., Greer & Greer, Channel 2, 54 kw visual, 27 kw aural
St. Cloud, Minn., Granite City Broadcasting Company, Channel 7, 23.5 kw visual, 12 kw aural
St. Louis, Mo., Broadcast House Incorporated, Channel 36, 275 kw visual, 145 kw aural
Watertown, N. Y., The Brockway Company, Channel 48, 185 kw visual, 100 kw aural
Wichita Falls, Tex., Wichita Falls Television Incorporated, Channel 6, 22.5 kw visual, 11.5 kw aural

SECTION MEETINGS

ATLANTA

"High Gain Antenna for Use in Television at WSB-TV," by R. A. Holbrook, WSB-TV; December 19, 1952.

BEAUMONT-PORT ARTHUR

"The Research and Development Program of Military Establishment at Texas University," by Dr. C P. Boner, Texas University; and Election of Officers; December 15, 1952.

CHICAGO

"Electronic Music—Past, Present and Future," by E. L. Kent, C. G. Conn, Ltd.; December 19, 1952.

CINCINNATI

"Man-Made Heat Waves," by A. G. Billin, Liebel Flarsheim Company; December 16, 1952.

CLEVELAND

"Problems of Electronic Recording in the Medical Sciences," by R. S. Alexander, Western Reserve; November 20, 1952.

"Psychology of the Design of Electrical Instruments," by D. B. Sinclair, General Radio Company; December 18, 1952.

COLUMBUS

"Space Travel," by F. McLean Mallett, Faculty, Ohio State University; December 2, 1952

"Energy in Action," presented by the Westinghouse Company; December 16, 1952.

CONNECTICUT VALLEY

"Engineering in Medicine," by J. H. Helle Faculty, Yale University; November 11, 1952.

"Measurements of Piezoelectric Constants," by W. L. Skeel, Student, Wesleyan University, and "Use of Barium Titanate in Condensers, Transducers, Dielectric Amplifiers and Storage Devices," by W. P. Mason, Bell Telephone Laboratories; November 20, 1952.

"Radio Television Interference Control," by P. Rand and A. Riley, Remington Rand, Inc.; December 11, 1952.

DAYTON

"Electronics in Music," by George Hadden, Minshall-Estey Company; January 8, 1953.

DENVER

"Results of Cheyenne Mountain Measurements Transmitting and Receiving Facilities Used in Tropospheric Propagation Studies at Cheyenne Mountain Field Station," by A. P. Barsis and M. T Decker, National Bureau of Standards; "1046 mc

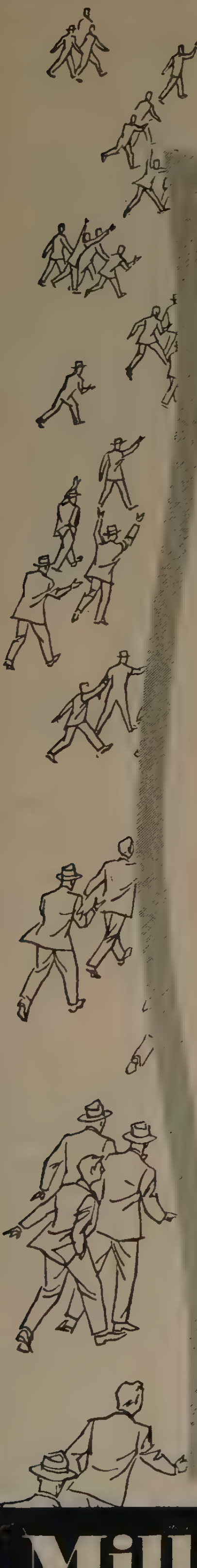
(Continued on page 106A)

at the **I.R.E.** show

GRAND CENTRAL PALACE

New York City

March 23 to 26



The divisions of Bendix exhibiting at this show are complete entities with their own manufacturing, research, sales and service organizations . . . although each can and does call on the knowledge and facilities of other divisions. This system makes possible a wide range of useful developments and also permits specialization to meet the needs of specific industries.

Bendix Radio

BALTIMORE 4, MD.

100% of the nation's airlines and more than 45 of the major railroads depend on Bendix Radio for precision electronic equipment.

Bendix Ground Controlled Approach is world famous. The Bendix radio compass is standard for the aviation industry. Bendix VHF communications and VOR navigation equipment are also recent Bendix developments.

See the VHF 2-way communications units for mobile service and the 360 channel VHF aircraft receiver on display.

Bendix

SCINTILLA MAGNETO DIVISION

SIDNEY, N. Y.

Bendix Scinflex Electrical Connectors have been an immediate success wherever used. Completely pressurized electrical connectors are for all contact sizes and pin arrangements and have full A.N. approval.

Another recent development is the Bendix ignition analyzer that checks efficiency of both ignition units and spark plugs and actually predicts performance failures before they occur.

Bendix Red Bank

EATONTOWN, N. J.

The Red Bank Division produces special purpose electron tubes and rotary power supplies. Units are designed for utmost durability to meet exacting requirements, and special purpose tubes such as Klystrons voltage regulators and spark gaps are available for non-standard applications. Rotary power supplies for operation from D.C. sources are produced in a wide variety of outputs—either A.C. or D.C.—regulated or unregulated.

Eclipse-Pioneer

TETERBORO, N. J.

Eclipse-Pioneer Division is one of the world's most prolific and versatile suppliers to precision industries. Famous for over 30 years for the quality and design superiority, Eclipse-Pioneer is today a major supplier of Gyroscopes, Synchros, Low Inertia Motors, Rate Generators, special purpose Amplifiers, and other precision components for servomechanism and computing equipment to the electronic industry—*and manufacturing capacity is now available for these specialized products.*

Pacific Division

NORTH HOLLYWOOD, CALIF.

The Pacific Division provides a striking example of Bendix talent in combining advance engineering design with production facilities to provide tomorrow's products today. This is well illustrated by the Pacific Division's outstanding leadership in the fields of sonar, telemetering, air-borne radar, hydraulic servomechanisms and radio control. Be sure to get a copy of the booklet "Electronic Progress at Bendix Pacific" at the Bendix booth.

Millions Trust

Bendix
AVIATION CORPORATION

MISSION: To eliminate the needless waste of manpower, machines, and technical skill in the modification of servo components.

In applying servo systems to their operations, many engineers are restricted by "stock" components. They either sacrifice efficiency by building systems around the components available, or waste manpower, machines, and skill in modifying units to make them useable.

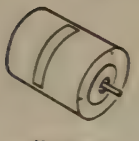
It is the mission of the Transicoil Corporation to provide precision components for each particular servo application . . . ready for immediate application . . . with all the accuracy and efficiency for which they are designed.

REFERENCE: Technical catalog "Precision Components" available upon request.

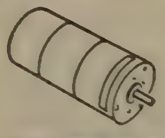
During the I.R.E. Show, see us at the Belmont Plaza Hotel, Suites 744, 745, 746.

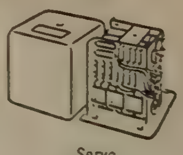
TRANSICOIL

CORPORATION 107 GRAND STREET
NEW YORK 13, N.Y.


Miniature
Control Motors

Motor and Gear
Train Assemblies


Motor, Generator, and
Gear Train
Combinations


Servo
Amplifiers

SECTION MEETINGS

(Continued from page 102A)

4 kw Klystron Transmitter at Cheyenne Mountain Field Station," by C. F. Peterson, National Bureau of Standards; January 9, 1953.

DES MOINES-AMES

"The Boolean Algebra Applied to Switching Circuits," by A. B. Kassander, Faculty, Iowa State College; December 11, 1952.

DETROIT

"Upper Atmospheric Research (Signal Corps Rockets)," by Fred Bartman, Faculty, University of Michigan; election of officers; December 19, 1952.

EMPORIUM

"Eisenhower's Problems in Korea," by J. A. Gathings, Faculty, Bucknell University; election of officers; December 16, 1952.

EVANSVILLE-OWENSBORO

"Super Fringe Propagation of TV Signals," by L. E. Raburn, Electronic Research, Inc.; December 10, 1952.

"A Creative Approach to Design Problems," by L. W. Guth, General Electric Company; January 14, 1953.

FORT WAYNE

"F.B.I. in Peace and War," by D. S. Horth, Federal Bureau of Investigation; January 6, 1953.

HAWAII

"Cosmic Disturbances," by Grote Reber, Research Corporation of New York; October 8, 1952.

"Super-Imposed Radio Communications on Power Transmission Systems," by Jack Barkel Westinghouse Electric and Manufacturing Company; November 20, 1952.

"Design and Operational Characteristics of Radar Systems," by L. M. Baxter, General Electric Company; December 10, 1952.

LITTLE ROCK

"UHF Tuners for TV Receivers," by W. J. Stolze, P. R. Mallory and Company; "Report on Status of New Little Rock Television Station," by J. H. Tudor, Little Rock Telecasters, Inc.; and election of officers; October 9, 1952.

LOS ANGELES

"Nuclear Reactor Kinetics and Control," by W. E. Parkens, North American Aviation, Inc.; January 6, 1953.

LOUISVILLE

"NTSC System of Color with Accent on Color Receiver Design," by R. B. McGregor; January 9, 1953.

NEW YORK

"Tropospheric Propagation Well Beyond the Horizon," by T. J. Carroll, Massachusetts Institute of Technology; December 3, 1952.

OKLAHOMA CITY

"A Cage Type VHF Antenna for the Phase Comparison Omnidirectional Radio Range (VOR)," by F. J. Lundberg, Federal Telecommunication Laboratories; October 14, 1952.

"Atomic Power Plants," by R. G. Lorraine, General Electric Company; November 18, 1952.

"Magnetic Resonance," by K. K. Darrow, Bell Telephone Laboratories; December 2, 1952

OTTAWA

"Research Establishments," by Sir Robert Watson-Watt, Adalia Limited; January 12, 1953.

(Continued on page 108A)

Simplify your production procedure with High-precision

Stupakoff

CERAMIC to Metal ASSEMBLIES

for Electrical and Electronic Applications

To combine ceramic and metal parts into one permanent unit, Stupakoff draws upon extensive experience with both materials. Methods of assembly employed by Stupakoff include: metallizing, soldering, pressing, spinning and others. Among the metals assembled to ceramics are silver, copper, brass, stainless steel and monel.

The rotor shafts shown above consist of metal bands attached securely to ceramic rods, and exemplify Stupakoff precision manufacture. On a mass production basis, concentricity of components, for example, are held to less than ± 0.001 in. Likewise, the strains and spreaders, stand-offs and trimmers shown below meet the exacting requirements of the service for which they are made.

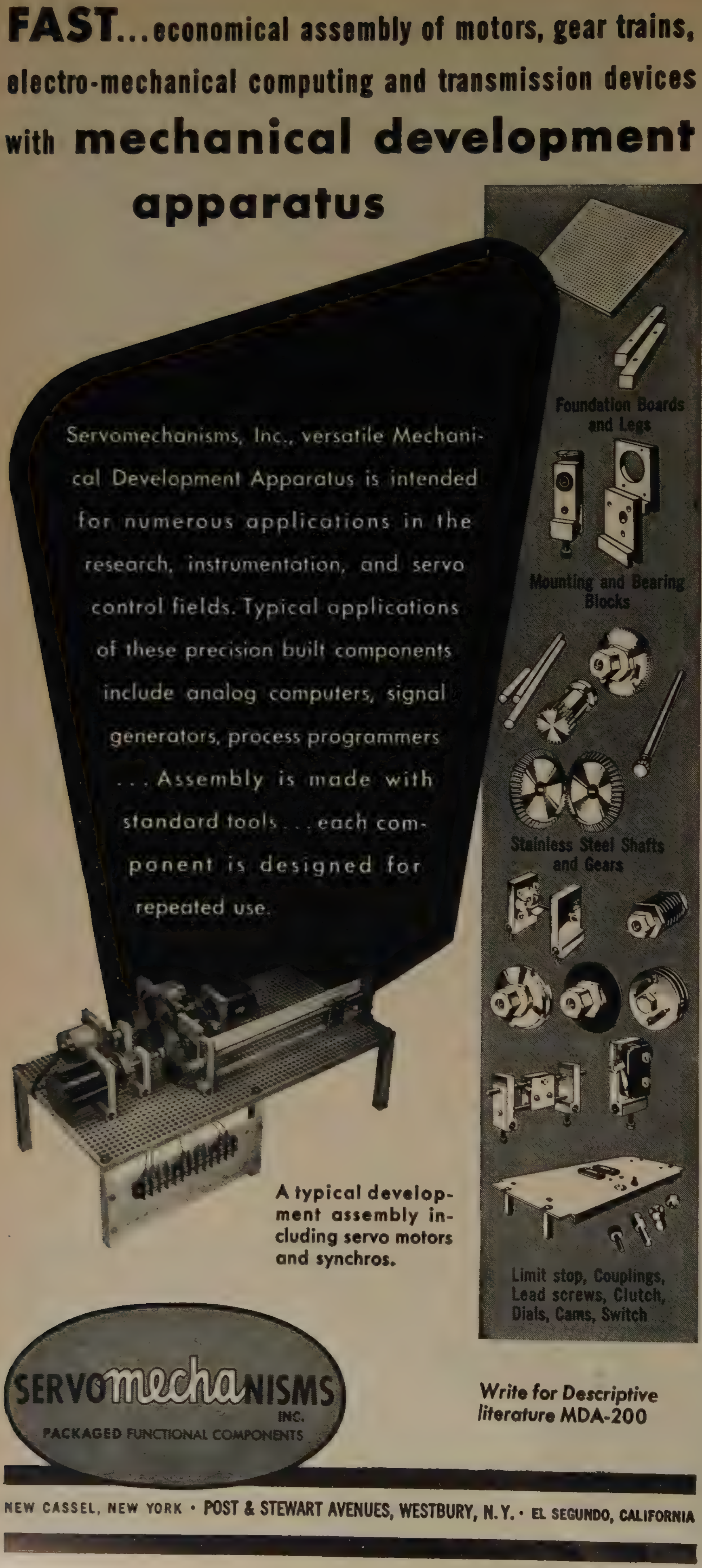
Stupakoff high-precision ceramic assemblies offer many opportunities to reduce costs, increase production and improve electrical and electronic equipment.

We will be glad to discuss your requirements with you and to submit samples for your inspection.

STUPAKOFF
CERAMIC & MANUFACTURING CO.

LATROBE, PENNSYLVANIA

See Us at Booth 3-105, Radio Engineering Show, March 23-26.



Foundation Boards and Legs
Mounting and Bearing Blocks
Stainless Steel Shafts and Gears
Limit stop, Couplings, Lead screws, Clutch, Dials, Cams, Switch

FAST...economical assembly of motors, gear trains, electro-mechanical computing and transmission devices with **mechanical development apparatus**

Servomechanisms, Inc., versatile Mechanical Development Apparatus is intended for numerous applications in the research, instrumentation, and servo control fields. Typical applications of these precision built components include analog computers, signal generators, process programmers . . . Assembly is made with standard tools . . . each component is designed for repeated use.

A typical development assembly including servo motors and synchros.

Write for Descriptive literature MDA-200

SERVOmechaNISMS INC.
PACKAGED FUNCTIONAL COMPONENTS

NEW CASSEL, NEW YORK • POST & STEWART AVENUES, WESTBURY, N.Y. • EL SEGUNDO, CALIFORNIA

SECTION MEETINGS

(*Continued from page 106A*)

PHILADELPHIA

"Switching Circuits for Automatic Control," by William Keister, Bell Telephone Laboratories; December 4, 1952.

PITTSBURGH

"Recent Developments in Broadband Microwave Amplifiers," by M. E. Hines, Bell Telephone Laboratories; December 15, 1952.

"Statistical Processes in Communications Engineering," by L. A. DeRosa, Federal Telecommunications Laboratories; January 12, 1953.

PORTLAND

"Pioneering in UHF Television," by Russel Olson, Station KPTV; "High Power Klystrons for UHF Television," by H. M. Stearns, Varian Associates; November 24, 1952.

"Germanium, The Magic Metal," by Fredrick Brown, Faculty, Reed College; "Model 2-C Idiosynchrovisor" by J. M. Henry and E. R. Moore (both talks tapescripts); December 11, 1952.

PRINCETON

"Nondestructive Testing," by R. C. McMaster, Battelle Memorial Institute; January 8, 1953

ROCHESTER

"Present and Future Fabrication Techniques of Printed Electronic Circuits," by William Tuscany, Globe Union, Inc.; November 20, 1952.

"Television and High Fidelity," by C. J Hunt and J. W. Farrell, Stromberg Carlson Company; December 9, 1952.

"Life Begins with Love," by Rev. J. F. Murphy, St. John Fisher College; December 16, 1952.

SACRAMENTO

"Some Interesting Aspects of Amplitude Modulation," by J. L. Reinartz, Eitel McCullough, Inc.; November 21, 1952.

"What is New in Science and Engineering," by E. S. Lee, Editor, General Electric Review; December 11, 1952.

SALT LAKE

"Research—Industry's Indispensable Ingredient," by F. R. Benedict, Westinghouse Electric Corporation; October 3, 1952.

"Mountain Top Television," by J. M. Baldwin, KDYL-TV, and V. E. Clayton, KSL-TV; December 15, 1952.

SAN ANTONIO

"Recent Developments in Radar Weather," by John Gerhardt, University of Texas; October 16, 1952.

SAN DIEGO

"Sea Surface Properties," by S. Q. Duntley, Scripps Institute of Oceanography; December 16, 1952.

SAN FRANCISCO

"Computer Engineering in Northern California," by P. Morton and Torben Meisling, University of California; J. L. Corl, Berkeley Scientific Company; G. B. Greene, Marchant Research; Jerre Noe, Stanford Research Institute; and L. D Stevens, IMB Corporation; November 12, 1952

"Radiation Theory in Retrospect," by S. A. Schelkunoff, Bell Telephone Laboratories; December 10, 1952.

SCHENECTADY

"Broadcast Station Monitoring Equipment," by H. R. Summerhayes, Jr., General Electric Company; October 20, 1952.

"Subminiaturization in Airborne Equipment," by D. W. Bulger and B. Pundick, General Electric Company; November 10, 1952.

(*Continued on page 116A*)

550 TO 3800 MEGACYCLES

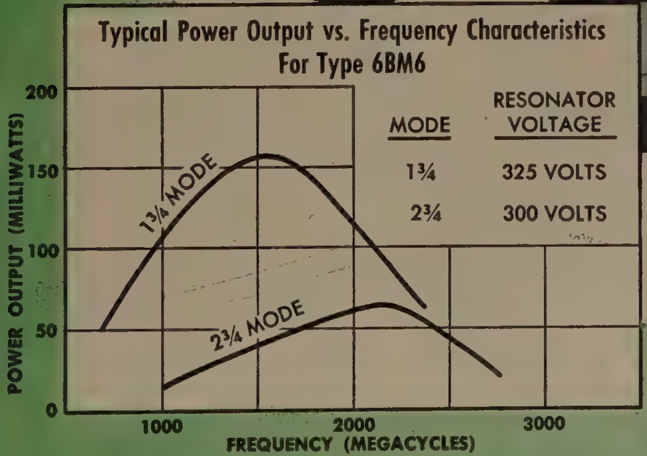
with Sylvania 6BM6 Broadband Tunable **KLYSTRONS**

Sylvania now offers 4 different Klystron types, designed for external cavity resonators covering a frequency range from 550 to 6500 megacycles.

Types 6BM6 and 6BL6 are designed for CW applications, while types 5836 and 5837 may also be used in pulse modulated oscillation.

Sylvania Klystrons provide continuous tunable output over wide ranges of the micro-wave spectrum. New illustrated catalog gives complete specifications. Mail the coupon for your copy now.

We also welcome your inquiries regarding the designing of cavities for various types of circuits.



SYLVANIA

ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

Sylvania Electric Products Inc.
Dept. 3E-4503, 1740 Broadway
New York 19, N. Y.

Please send me new catalog describing Sylvania's line of Reflex Klystrons.

*Name*____________________

*Street*____________________

*City*____________ *Zone*____ *State*____

we don't shrink heads...

but we do shrink

Transformers!

If you think Jivaro Indians were experts at shrinking things . . . (human heads, that is) . . . look what STANCOR engineers have done with transistor transformers! Recently they designed and are now producing the smallest transformer ever built!

How big is this new transformer? Well, it's just ¼″ x ⅜″ x ⅜″ and it weighs only 0.07 ounce. Designed especially for transistor applications, this unit is no larger than the transistor it powers.

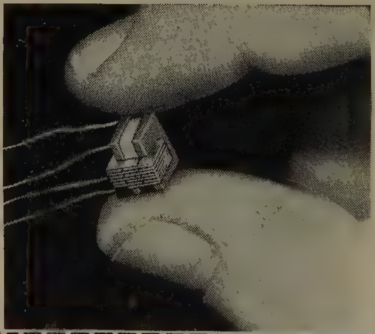
It is one of a series of transistor transformers, being built by Stancor, for development and commercial applications. If you are planning to use transistors, take advantage of Stancor's knowledge of engineering and manufacturing of ultra-miniature transformers.

STANCOR TRANSISTOR TRANSFORMERS

These stock transistor transformers are available through your Stancor distributor:

TYPE	APPLICATION	PRI. IMP.	SEC. IMP.
UM-110	Interstage	20,000	1,000
UM-111	Output or matching	1,000	60
UM-112	High imp. mic. to emitter	200,000	1,000

Other transistor transformers, built to your special requirements, are available for original equipment production only. Write for Bulletin 462.



STANCOR TINYTRANS

Miniature, cased audio transformers

Here are four new cataloged high fidelity transformers for use where space is at a premium. These units have a frequency response of ±1 db, 30-20,000 cps. They are impregnated and sealed in a ⅞″ square, drawn aluminum can, with ⅛″ terminals mounted on a phenolic terminal board. Total height is 1¼″.

TYPE	APPLICATION	PRI. IMP.	SEC. IMP.
TT-11	Mic., pickup or line to single grid.	50, 200/250, 500/600	50,000
TT-12	Mic., pickup or line to push-pull grids.	50, 200/250, 500/600	50,000
TT-13	Dynamic mic., to single grid.	7.5/30	50,000
TT-14	Single plate to single grid.	15,000	60,000

Ask your Stancor Distributor for Bulletin 463 on Stancor Tinytrans, or write us for your free copy.

STANCOR

STANDARD TRANSFORMER CORPORATION

3582 ELSTON AVENUE • CHICAGO 18, ILLINOIS

EXPORT SALES: Roburn Agencies, Inc., 39 Warren Street, New York 7, N. Y.

Section Meetings

(Continued from page 108A)

"Radio Communication in Industry," by J. A. McCormick, General Electric Company; December 10, 1952.

"Processing and Pressing of Transcriptions and Phonograph Records," by K. R. Smith, Allied Record Company; January 12, 1953.

SYRACUSE

"UHF Television," by C. G. Lloyd, General Electric Company; January 8, 1953.

TOLEDO

"Present Status of Transistor Development," by J. A. Morton, Bell Telephone Laboratories; January 14, 1953

TORONTO

"Antennae for Circular Polarization," by George Sinclair, Sinclair Radio Laboratories; January 5, 1953

TULSA

"Fundamental Theory of Transistors," by W. A. Adcock, Stanolind Oil and Gas Company; December 17, 1952.

VANCOUVER

"Electronic Equipment on Jet Transports for Trans-Pacific Service," by Phil Kenney, Canadian Pacific Airlines; November 17, 1952.

"Germanium Devices," discussed by L. R. Kersey; December 15, 1952.

WASHINGTON, D. C.

"Recent Developments in Vibrators and Vibrator Power Supplies," by Joseph Mas, Vibration Research Laboratory; December 8, 1952

WILLIAMSPORT

"The Application of Transistors to Home Receiver Design," by R. A. Jacobs, Westinghouse Electric Corporation; November 19, 1952

SUBSECTIONS

AMARILLO-LUBBOCK

Demonstration and Lecture on "Microwaves," by C. M. McKinney, Faculty, Texas Technological College; December 17, 1952.

CENTRE COUNTY

"Retrospect," by L. A. Poggett, Faculty, Pennsylvania State College; October 21, 1952.

"Discussion of Aims of Subsection," by Carl Volz, Chairman of Centre County Subsection; November 18, 1952.

"Ignitron Rectifier in Electric Locomotives," by W. M. Hutchison, Westinghouse Electric Corporation; "Comparison of Electric Locomotives," by S. V. Smith, Pennsylvania Railroad; December 16, 1952

LONG ISLAND

"Magnetic Amplifier Servo Applications," by S. B. Cohen, Sperry Gyroscope Company; December 9, 1952.

MID-HUDSON

"Guided Missiles," by J. Fletcher, Hughes Aircraft Company; December 16, 1952

NORTHERN NEW JERSEY

"A Survey of Magnetic Amplifiers," by George Wolf, General Electric Company; December 10, 1952.

PALO ALTO

Symposium on "Non-Vacuum Tube Amplifiers" Speakers: H. E. Hollman, Naval Air Missile Test Center; O. J. M. Smith, Faculty, University of California; H. M. Zeidler, Stanford Research Institute; December 3, 1952.

WICHITA

"Induction Heating," by F. R. Hunter, Allis Chalmers Manufacturing Company; "Spot-Welding and Electronics," by H. R. Sartin, Boeing Airplane Company; December 6, 1952

A visit with us will prove how we Control Uniformity in the manufacture of Metal-to-Glass Vacuum Seals.

IRE SHOW MARCH 23 to 26
FOURTH FLOOR
GRAND CENTRAL PALACE

- CRYSTAL HOLDERS
- MULTI-PIN HEADERS
- SINGLE TERMINALS
- SINGLE END SEALS
- MULTI-PIN CON PLUGS
- VACUUM COATING EQUIPMENT

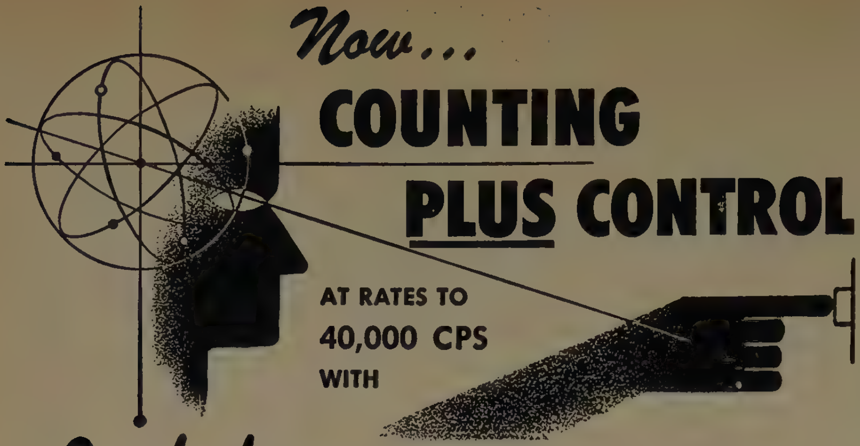
L. L. Constantin & Co.

MANUFACTURING ENGINEERS • LODI, NEW JERSEY • PRESCOTT 7-0223

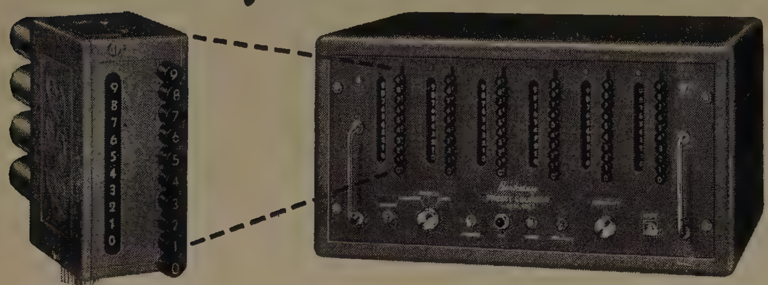
Now...

COUNTING PLUS CONTROL

AT RATES TO 40,000 CPS WITH



Berkeley PRESET COUNTERS



DESCRIPTION—The Berkeley Preset Counter is an electronic decade with provisions for producing an output signal or pulse at any desired preset count within the unit's capacity. Any physical, electrical, mechanical or optical events that can be converted into changing voltages can be counted, at rates from 1 to 40,000 counts per second. Total count is displayed in direct-reading digital form. Presetting is accomplished by depressing pushbuttons corresponding to the desired digit in each column. Model 730 Preset Decimal Counting Units are used. These are completely interchangeable plug-in units designed for simplicity of maintenance and replacement.

APPLICATIONS—Flexibility and simplicity of operation make the Berkeley Preset Counter suitable for both production line and laboratory use. It has practical applications wherever signalling or control, based on occurrence of a predetermined number of events or increments of time is desired. Output signals from the unit can be used to actuate virtually any type of process control device, or to provide aural or visual signals.

SPECIFICATIONS	Model				
	422	423	424	425	426
MAX. COUNT CAPACITY	100	1000	10,000	100,000	1,000,000
INPUT SENSITIVITY (MIN.)	± 1 v. to ground, peak; at least 2 μ sec. wide				
OUTPUT	Choice of pos. pulse and relay closure, or pos. pulse. SPST relay closure approx. 1/30 sec; pulse output is + 125 v. with 3 μ sec. rise time and 15 μ sec. duration.				
PANEL DIMENSIONS	15⅜" x 8¾"		19" x 8¾"		
OVERALL DIMENSIONS	16⅝" x 10¼" x 13"		20¾" x 10½" x 15"		
POWER REQUIREMENTS	117 v. ± 10% @ 90w.		117 v. ± 10% @ 180 w.		
PRICE (F.O.B. FACTORY)	$375	$450	$595	$695	$795

M3

For complete information, please request Bulletin 203

Berkeley Scientific

division of BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVENUE • RICHMOND, CALIFORNIA

"DIRECT READING DIGITAL PRESENTATION OF INFORMATION"

What to see at the Radio Engineering Show

(Continued from page 64A)

Firm — **Booth**

Bogue Electric Mfg. Co., Paterson 3, N.J. 4-205
Magnetic Amplifier systems for voltage regulation of generators and power supplies and speed and position control of D.C. motors, quality selenium rectifiers. 400 cps supplies and D.C. supplies.

Bomac Laboratories, Inc.
Beverly, Mass.
4-907

For Gas Switching Tubes—Bomac has available an extensive line of TR, ATR, Pre-TR and Attenuator tubes covering all the frequency bands and power levels in use. Many types are in high level production; specialized types can be supplied on short notice.

Bond Electronics Corp.
Springfield, N.J.
4-614

Wire-wound resistors—coils and associated assemblies.

Boonton Radio Corp.
Boonton, N.J.
2-251 & 522

Q-Meters—Low Frequency and VHF, FM-AM Signal Generators. Signal Generators for Telemetering, Aircraft Navigation Receiver Signal Generators, High Frequency Bridges, Aircraft Instrument Landing System Signal Generators. S-Band Radar Test Sets, Instruments for Measuring Low Loss Insulating Materials.

Borg Equipment Div.
George W. Borg Corp.
Janesville, Wis.
2-517

Borg Micropot Potentiometers, Borg Micropot Ten Turn Counting Dials, Precision Frequency Standards.

W. H. Brady Co., Chippewa Falls, Wis. 2-503
Brady self-sticking industrial products including wire markers, special markers, pipe markers, safety signs, masks and printed roll tape.

William Brand Co., Inc., Willimantic, Conn. 4-519
Turbo Electrical Insulating Materials—Varnished Tubing, Saturated Sleeving, Turbotuf Tubing and Sleeving, etc.; Turbotherm Insulated Plastic Wire, Extruded and Varnished Cambric Markers, etc.

H. Braun Tool & Instrument, Inc., 140 5th Ave., Hawthorne, N.J. 4-424
Beryllium copper and other metal stampings, electronic contacts—grounding strips flat-springs-diaphragms. Aircraft propeller precision parts and other metal fabrication.

Brentano's Technical Book Dept., New York 36, N.Y. 2-501 & 502
Technical books of all publishers in the fields of radio, television, electronics and nucleonics—including the related fields of mathematics and physics.

(Continued on page 128A)

*Isotronic** PRODUCTS

STANDARD UNITS AND SPECIFICATIONS

RANGERS (Full-range-variable DC Supplys)	Input range	95 — 130 VAC, 1Φ, 50 — 60~.			
	Reg. accuracy	±0.25% at any voltage setting.			
	Ripple	1% RMS max.			
	Output	Model	SR-100	SR-30	SR-2
		VDC	3-135	3-30	100-300
		Amps	1-10	3-30	1-10

±0.01% ACCURACY MODELS

Super-accurate AC Line Regulator Model 1001	Load range	0 — 1000 VA
	Input volt. range	95 — 130 VAC, 1Φ, 55 — 65~.
	Load P. F. range	0.7 lagging to 0.95 leading
	Output voltage	115 VAC, 1Φ (adjustable from 110-120 volts)
	Distortion	3% max.
	Time constant	0.1 seconds
	Reg. accuracy	±0.01%
DC Power Source for Spectrophotometers Model E-6/2-5 Nobatron	Input volt. range	95-130 VAC, 1Φ, 50-60 cycles
	Output	
	#1 for lamp	6VDC adjustable ±10% at 5 amperes
	#2 for filament	6VDC at 100 Ma.
	#3 for bias	2VDC adjustable ±10% at 100 Ma.
	Filtering	
	#1	1% max.
	#2 & 3	0.05% max.
	Reg. accuracy	±0.01% against line changes
	Time constant	0.1 seconds under most severe line changes

FREQUENCY CHANGERS

MODELS FCD250 FCD500 FCD1000 (the above change 50-60 cycles to 400 cycles; capacities of 250, and 1000 VA. Input 230VAC ± 10%, 1Ø, or 208VAC ± 10%, 1Ø.) FC1000 (the above changes 50-60 cycles to 60 cycles regulated; capacity 1000 VA. Input 105-125VAC, 10.)	Input voltage	105-125 VAC, 1Ø
	Input frequency	50-60 cycles
	Output voltage	115 VAC, 1Ø, adjustable between 110-120 VAC
	Output frequency	60 and 400 cycles ±10%
	Output voltage regulation	±1.0%
	Output frequency regulation	±1% in standard model ±0.01% with auxiliary frequency standard
	Load range	0.1 to full load
	Distortion	5% maximum
	P. F. range	Down to 0.5 lagging
	Time constant	0.5 seconds
	Envelope modulation	2% maximum

NEW cheap DC POWER SUPPLIES

DUAL OUTPUT (Model 350B)	
NPUT	105 - 125 VAC, 50 - 60~, 1Ø.
OUTPUT	1. 175-350 VDC @ 0-60 Ma simultaneously from two independently adjustable outlets. 2. 175-350 VDC @ 0-120 Ma from one outlet. 3. 0-175 VDC @ 0-60 Ma from one outlet. 4. 6.3 VAC @ 5 amps., C.T., unregulated.
OUTPUT REG.	±1.0% max. or 1.5 volts (which is greater).
RIPPLE	10 mv
IZE	13" x 7½" x 8"

TUBELESS—GERMANIUM (Model 300G)	
Input	0-125 VAC, 1Ø, 50-60~
Output	0-300 VDC
Load range	0 - 0.6 amps.
Ripple	2% at 300 v. to 5% at 100 v.
Regulation	No line regulation. ± 1.0% with output voltage setting between 100 and 300 VDC with a load change from .06 amperes to 0.6 amperes. Useful performance available at lower output voltages (typical data available upon request).
AC output	0-125 VAC @ 115 volts input. 5 ampere capacity. Not available simultaneously with DC output.
Mechanical—no meters. Size 12" x 8" x 8".	

COAST TO COAST

Authorized Sorensen representatives and their field engineers are listed below. Find the one located nearest you — don't hesitate to call on him for consultation and advice.

CALIFORNIA — HOLLYWOOD
Neely Enterprises
7422 Melrose Ave.; Phone Whitney 1147

CALIFORNIA — SACRAMENTO
Neely Enterprises
1317-15th St.; Phone Gilbert 2-8901

CALIFORNIA — SAN FRANCISCO
Neely Enterprises
2830 Geary Blvd.; Phone Walnut 1-3960

COLORADO — DENVER
Ronald G. Bowen
852 Broadway

D.C. — WASHINGTON
Burlingame Associates — F. L. Horman
2017 S St., N.W.; Phone Decatur 8000

FLORIDA — FORT MEYERS
Arthur H. Lynch & Associates
P. O. Box 466; Phone 5-6762

GEORGIA — ATLANTA
Floyd Fausett & Son
777 Pinehurst Terr.; Phone Raymond 3104

ILLINOIS — CHICAGO
Loren F. Green & Associates
4949 W. Diversey Ave.; Ph. National 2-2370

KENTUCKY
H. A. Watson, Jr.
817 Citizens Bldg.; Cleveland, Ohio

MASSACHUSETTS — BOSTON
Burlingame Associates — P. G. Yewell
270 Commonwealth Ave.; Ph. Kenmore 6-8100

MICHIGAN — DETROIT
S. Sterling Company
15310 W. McNichols Rd.; Ph. Broadway 3-2900

MISSOURI — SAINT LOUIS
Harris Hanson Co.
5506 S. Kings Highway

NEW MEXICO — ALBUQUERQUE
Neely Enterprises
107 S. Washington St.; Phone 5-8731

NEW YORK — SYRACUSE
Burlingame Associates — J. D. Ryerson
712 State Tower Bldg.; Phone 2-0194

NEW YORK — NEW YORK
Burlingame Associates
103 Lafayette St.; Phone Digby 9-1240

NORTH CAROLINA — CHARLOTTE
James L. Highsmith
P. O. Box 1011; Phone 5-6436

OREGON — PORTLAND
The James L. Kearns Co.
P. O. Box 5108; Phone East 4331

PENNSYLVANIA — PHILADELPHIA
Burlingame Associates — Ivan Robinson
7060 Garret Rd. (Upper Darby);
Phone Flanders 2-1597

PENNSYLVANIA — PITTSBURGH
H. E. Ransford & Co.
Grant Bldg.; Phone Grant 1-1880

TENNESSEE — KNOXVILLE
A. R. Hough
P. O. Box 1452; Phone 8-4312

TEXAS — HOUSTON
Earl W. Lipscomb & Associates
2420-B Rice Blvd.; Phone Linden 9303

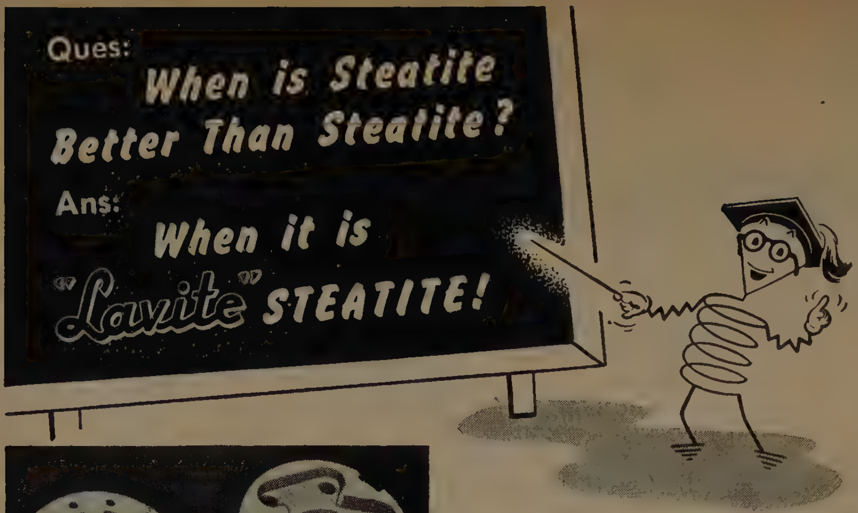
TEXAS — DALLAS
Earl W. Lipscomb & Associates
5103 W. Lovers Lane; Phone Elmhurst 5345

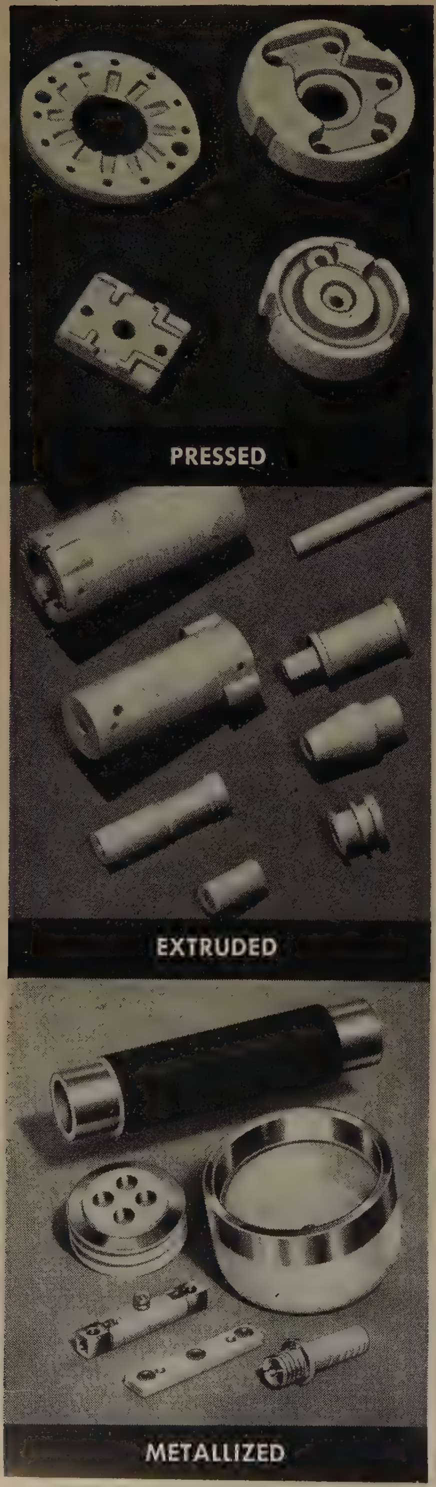
CANADA — TORONTO, ONT.
Charles W. Pointon
1926 Gerrard St., East; Phone Oxford 7435

Specify **SORENSEN**

See Us at Booth 2-318, 319
I.R.E. Show, March 23-26

SORENSEN AND COMPANY • 375 FAIRFIELD AVE., STAMFORD, CONN.


Ques:
When is Steatite Better Than Steatite?
Ans:
When it is "Lavite" STEATITE!



—and here's why!

1. Any material that is kept under perpetual research and redevelopment, as "Lavite" Steatite has always been, is naturally superior to like material produced to conventional standards.

2. Your parts (trimmer bases, coil forms, strain reliefs, tube base sockets and hundreds of others), produced in "Lavite" Steatite may be extruded or pressed, and in either case machined to close tolerances.

3. Being a product of private research, you are assured laboratory control in every step of production.

4. Selection of specific properties is no problem.

5. Unusual shapes and mechanical oddities are accepted as routine.

6. Perhaps metallizing of your parts will help you cut assembly time—a Steward Specialty.

Remember—Steward's Engineers are Your Engineers. Use them often. Our recommendations are a service to you—no obligations.

• *Ask for booklet giving characteristics of all "Lavite" Ceramics ("Lavite" Steatite, "Lavite" Titanates, "Lavite" Ferrites and others).*

D. M. STEWARD
MANUFACTURING CO.
3605 Jerome Avenue, Chattanooga, Tenn.
Sales Offices in Principal Cities

What to see at the Radio Engineering Show

(Continued from page 124A)

Firm **Booth**

Ersin Multicore Solders
Div. of British Industries
New York 13, N.Y.
2-515

"AVO" Line of Douglas and Macadie Coil Winding Machines, Widney-Dorlec Cabinets, "Expamet" Expanded Aluminum Grill Material, Germanium Diodes, Selenium Rectifiers, KT 66 Tubes.

Brooks & Perkins, Inc., Detroit 16, Mich. **1-706**
Magnesium assemblies for electronic systems—radar reflectors, pillbox-type wave guide, electronic housings, military equipment, missile air-frame assembly, teletypewriter housings.

Brown Electro-
Measurement Corp.
Portland 15, Oregon
4-917

PRODUCTS: Dekapots and Dekastats—Precision high resolution potentiometers and rheostats featuring the BECO DEKADIAL. Portable and laboratory Impedance Bridges. Battery and ac operation null amplifiers. Miniature precision decade boxes.

Browning Laboratories, Inc., Winchester, Mass. **2-106 & 107**
Introducing our new—Models OL-23 Oscillosynchroscope; OA-16 Oscillosynchroscope; TVN-11 Power Supply; TAA-16B SWR Amplifier; MD-33 Frequency Modulation Monitor; RJ-42 FM-AM Tuner.

Brush Electronics Co.
Cleveland 14, Ohio
1-809, 810, & 811

Synthetic Prezo-Electric Materials, Acoustic Products, Magnetic Recording Components, Industrial and Laboratory Instruments and Hypersonic Generator and Transducer.

H. H. Buggie and Co.
Toledo 1, Ohio
4-520

Many types of special and standard connectors (Receptacles and plugs) cable assemblies and component parts for the electronics industry.

BURLINGAME ASSOCIATES

LABSCOPE precision equal-amplifier OSCILLOSCOPES

haledy cold-cathode, industrial CONTROLS and COUNTERS—totalizing and preset

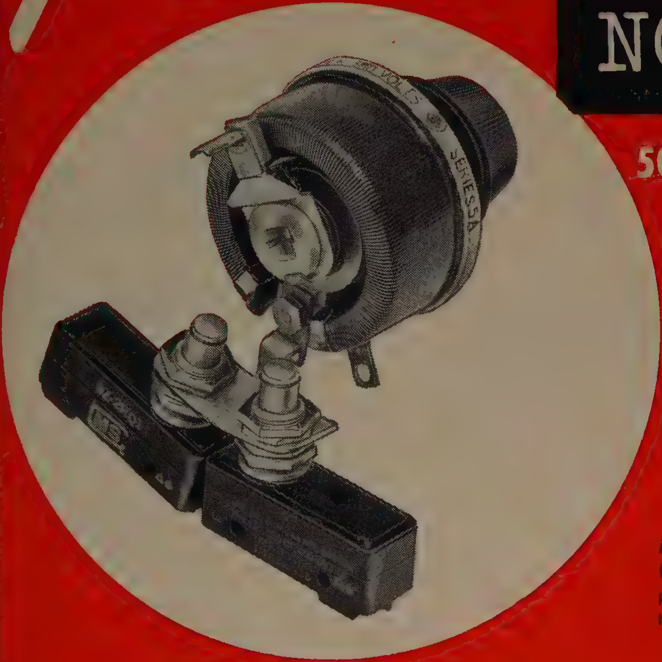
BOOTHS: 2-135-136

(Continued on page 130A)

TRU-OHM

Power Rheostats

NOW Available!

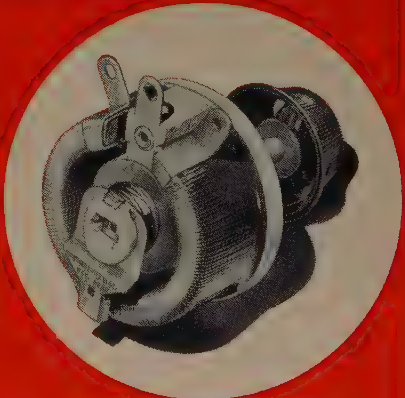


50 watt - 75 watt - 100 watt - 150 watt
(25 watt available shortly)

Special Features:

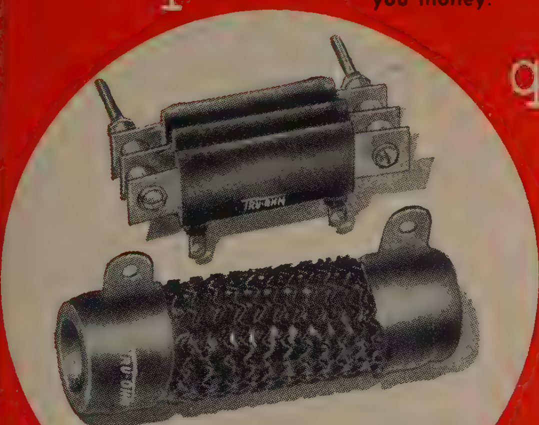
- ★ tapered windings
- ★ switch combinations
- ★ off positions
- ★ special shaft assemblies
- ★ tandem assemblies

May we have your prints for quotations and sampling? Prompt and courteous service is assured.



delivery we guarantee immediate delivery regardless of quantity, value and sizes.

price we guarantee that our prices will always save you money.



TRU-OHM VITREOUS ENAMELED RESISTORS — A complete line ready for shipment!

quality we guarantee our engineering techniques and selection of materials will provide the finest products available.

approval we guarantee to meet the requirements of the most rigid specifications.

TRU-OHM RHEOSTATS and RESISTORS are approved by the foremost manufacturers for civilian and government applications.

TRU-OHM PRODUCTS Division of Model Engineering & Mfg., Inc.

General Sales Office: 2800 N. Milwaukee Avenue, Chicago 18, Ill.
Factory: Huntington, Indiana

MANUFACTURERS: Power Rheostats, Fixed Resistors, Adjustable Resistors, "Econohm" Resistors, "Tru-rib" Resistors

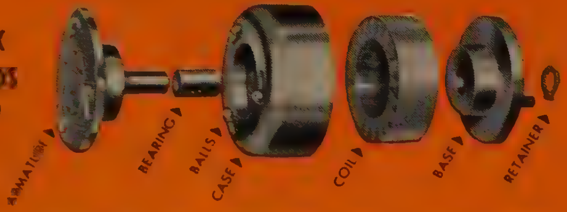
LEDEX ROTARY SOLENOIDS

...give positive, powerful snap action!

here's how a
LEDEX ROTARY SOLENOID
operates...

The magnetic pull moves the armature along the Solenoid axis. This action is efficiently converted into a rotary motion by means of ball bearings on inclined races. The inclined ball races are made to compensate for the magnetic pull increase as the Solenoid air gap closes, thereby providing substantially constant torque throughout the Solenoid stroke. The rotary snap-action power of the Ledex can be efficiently harnessed with a minimum of linkages, through the use of one or more standard features available on all models.

here's why LEDEX ROTARY SOLENOIDS are dependable!



As can be seen from the exploded view, Ledex Rotary Solenoids are simply constructed with few moving parts. All parts are manufactured to exacting tolerances and are carefully inspected and assembled.

The copper wire coil, the heart of the Solenoid, was developed especially for this product. It is wound by a precision winding process that puts a maximum amount of magnet wire into available space . . . giving tremendous power to compact Ledex Rotary Solenoids.

six basic LEDEX ROTARY SOLENOIDS to choose from!

Model Number	2	3	5	6	7	8
Diameter	1⅛"	1 5/16"	1⅞"	2¼"	2¾"	3⅜"
Torque lb.-in.*	¼	1	5	10	25	50
Weight lbs.	⅛	¼	½	1	2¼	4¼

*45° stroke intermittent duty.

Engineering data is available upon request. Write for descriptive literature today!

G.H. Leland INC.

123 WEBSTER STREET, DAYTON 2, OHIO

What to see at the Radio Engineering Show

(Continued from page 128A)

Burlington Instrument Co.
Burlington, Iowa
2-323
AC and DC Electrical Indicating Instruments.

Firm	Booth
Burroughs Adding Machine Co., Philadelphia 23, Pa. Computer components; Pulse control units; computation services.	4-921

FUSETRON
TRUSTWORTHY NAMES IN ELECTRICAL PROTECTION
BUSS
FUSES

Bussmann Mfg. Co., St. Louis 7, Mo. 3-120
Buss Fuse Display will show small dimension fuses of various types. Fusetron dual-element (slow blowing) fuses, fast acting fuses for instrument protection—and fuses of all types for the protection of television, radio, controls, avionics, and automobiles. Plus many kinds of fuse blocks, fuse clips and fuse holders.

CGS Laboratories, Stamford, Conn. 2-125 & 126
Increductor controllable inductors—no moving parts. Dynamic display showing wide range of response, operation at high and low frequencies, fast response, Q-meter demonstration. Microwave miniaturized S-Band cavity oscillator using pencil tube series, ruggedized to meet up to 1000 G acceleration. Stable to ± 2 mc under all operating conditions.

C & H Supply Co., Seattle, Wash. 3-526
Metal-Cal. identification name plates and circuit diagrams.

The Calidyne Co., Winchester, Mass. 2-518
VIBRATION TEST EQUIPMENT— Calidyne electro-dynamic Shakers—25 pound, 600 pound, 1250 pound, and 2500 pound force output. Accelerometer and Velocity Pickup Calibration Systems. Accelerometers and Accelerometer Couplers. Vibration Meter and Signal Monitor for velocity signal generators. Vibrascope, Calivolter.

Cambridge Thermionic Corp.
Cambridge 38, Mass.
2-218
Electronic Components, Terminals, Terminal Boards, Coils, Coil Forms, Insulated Units, etc.

Canadian Radium & Uranium Corp., 630 Fifth Avenue, New York 20, N.Y. 4-522
Consult us on all luminous applications to instrument dials, panels and all other components. We manufacture complete dials, panels, etc., to your specification.

(Continued on page 132A)

AMERICAN LAVA CORPORATION... SPOTLIGHTS ALSIMAG® METAL-CERAMIC COMBINATIONS

Lead-Through Hermetic Terminals

(Designed for soft-soldering)

Superior ceramic terminals for hermetic seals are now available in an AlSiMag Alumina Body which meets L5A Requirements of JAN-I-10 specifications.

Some sizes and styles are carried in stock . . . or they can be custom made for your specific requirements. *STOCK ITEMS ARE SHOWN IN BULLETIN NO. 524, SENT ON REQUEST.*

Our broad experience in metal-ceramic combinations is available to you on your request.

51ST YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-8159 • SYRACUSE, N. Y.: 330 Arlington Ave., Phone 76-5068 • CLEVELAND: 5012 Euclid Ave., Room 2007, Express 1-6685
NEW ENGLAND: 1374 Mass. Ave., Cambridge, Mass., Kirkland 7-4498 • PHILADELPHIA: 1649 N. Broad St., Stevenson 4-2823 • ST. LOUIS: 1123 Washington Ave., Garfield 4959
CHICAGO: 228 N. LaSalle St., Central 6-1721 • SOUTHWEST: John A. Green Co., 6815 Oriole Dr., Dallas 9, Dixon 9918 • LOS ANGELES: 5603 N. Huntington Dr., Capital 1-9114

new
HEPPNER
"GUARANTEED COUNT" ELECTRO-DYNAMIC
speakers

With EXCLUSIVE "No-Rub" Voice Coil

ABSOLUTE UNIFORMITY TO YOUR SPECIFICATIONS BECAUSE:

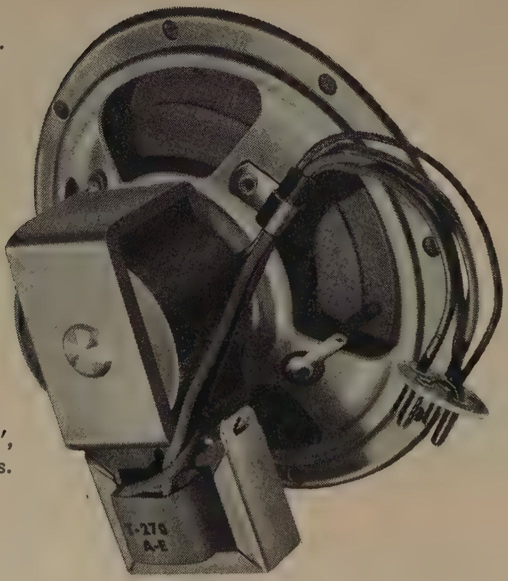
- EACH FIELD COIL GUARANTEED TO CONTAIN GIVEN NUMBER OF TURNS within standard tolerance. Quality fully controlled because all coils are wound by Heppner. No wire-stretching or other quality-reducing shortcuts. Resistance and wire size to your exact specifications.

- THE *EXCLUSIVE* HEPPNER PERFECTLY ROUND "NO-RUB" VOICE COIL is now available in Electro-Dynamic Speakers. This coil is installed perfectly round by means of a Heppner developed process which eliminates all egg-shaped coils which cause rubs.

Electro-Dynamic Speakers are available with or without bucking coils, transformers, plugs and/or brackets to your specifications.

Engineered for efficiency and fine acoustical performance. Exceptionally thorough final inspection.

Write for
further information today.



Available in 3", 4", 5", 6½",
10", 12" sizes.

HEPPNER
MANUFACTURING COMPANY
Round Lake, Illinois (50 Miles Northwest of Chicago)
Phone: 6-2161
SPECIALISTS IN ELECTRO-MAGNETIC DEVICES

Representatives;
James C. Muggleworth
506 Richey Ave., W., Collingswood, N. J.
Ralph Haffey
2417 Kenwood Ave., Ft. Wayne 3, Indiana
Irv. M. Cochrane Co.
408 So. Alvarado St., Los Angeles, California

What to see at the Radio Engineering Show

(Continued from page 130A)

Cannon Electric Co.
Los Angeles 31, Calif.
2-512

The widest selection of multi-contact electric connectors, including Mil Spec. types "AN," etc. Audio types P, O, X, XK, XL, U. Subminiatures will be featured, together with hermetic sealed also in sub-miniature. DC Solenoids are included in the exhibit.

Capitol Radio Engineering Institute, Washington 10, D.C. 3-106
CREI home study courses in Radio, Electronics and Television Engineering.

Carboloy Dept., General Electric Co., Detroit 32, Mich. 1-601
Carboloy Permanent Magnets, Carboloy Thermistors, and some suggested applications of these products. The display will also include one or two customer participation units.

Cargo Packers, Inc.
Brooklyn 11, N.Y.
4-802

Custom engineered packaging for the electronics industry featuring climate proof and shock proof designs for all applications—military and civilian. See fresh new approaches to transmitter tube and magnetron pack design. Specializes in packaging and packing of extremely delicate, sensitive electronic assemblies and components.

Centralab
A Div. of Globe-Union Inc.
900 East Keefe Ave.
Milwaukee 1, Wisconsin
SINCE 1922
"First in Components Research"

Centralab Div. of Globe-Union, Inc., Milwaukee 1, Wis. 2-403 & 404
The latest engineering developments and items produced by the pioneer and leader in electronic components. On display are new variable resistors, ceramic capacitors, rotary tone, lever, slide, and power switches, ceramic insulators and forms, and printed electronic circuits. Commercial and Military applications are covered.

Century Geophysical Corp., Dallas, Texas. 3-203
Recording Oscillographs, Recording Galvanometers, Linear-Integrating Amplifiers, Carrier Amplifiers.

Chase Resistor Co., Morristown, N.J. 4-712
Miniature hermetically sealed deposited carbon resistors for high temperature application. Rod and Disc. coated resistors for Microwave frequencies. Glass sealed helium filled resistors for precision networks.

Chatham Electronics Corp.
Livingston, N.J.
4-512

Electronic Tubes and Portable Equipment Units.

(Continued on page 134A)

Winchester Electronics Incorporated

ELECTRICAL CIRCUIT CONNECTORS

..can solve your toughest weight and space problems!

Our Engineering and Development Department can help you with your requirements for special connectors.

SERIES "A"

1/2 ACTUAL SIZE

SERIES "HMRE"

ACTUAL SIZE

SERIES "SMRE"

ACTUAL SIZE

SERIES "CR"

1/2 ACTUAL SIZE

SERIES "MRE"

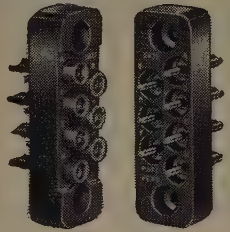
2/3 ACTUAL SIZE

DESCRIPTION	Types Available
LIGHTWEIGHT AIRCRAFT TYPE Polarized; Rack, Panel or Cable mounted—with Hood or Clamp and Cable strain relief.	*Receptacle* — *Plug* A7S — A7P A10S — A10P A15S — A15P A18S — A18P (Figures in above Code Nos. indicate number of contacts.)
HERMETIC PLUG Each special contact fused in glass into special base plate provided for soldering into a rectangular hole in an hermetically sealed housing or bulkhead. Used with Standard "MRE" Receptacle.	*Plug* HMRE7P-G HMRE9P-G HMRE14P-G HMRE18P-G HMRE20P-G HMRE21P-G HMRE26P-G HMRE34P-G HMRF41P-G HMRE50P-G (Used with Standard MRE Receptacles)
SUB-MINIATURE For Aircraft, Instruments and Portable Equipment Light weight, Polarized, Self-aligning with special guide pins. Rack, Panel or Cable mounted with Hood and Cable strain relief.	*Receptacle* — *Plug* SMRE7S-G — SMRE7P-G SMRE14S-G — SMRE14P-G SMRE20S-G — SMRE20P-G SMRE26S-G — SMRE26P-G SMRE29S-G — SMRE29P-G SMRE34S-G — SMRE34P-G (Other sizes to meet your requirements)
MINIATURE PRESSURE-TIGHT This connector is typical of several recent designs requiring a miniature connector (1″ dia. x 1⅞″ lgth.) in an aluminum die-cast shell. It is sealed with neoprene gaskets around the inserts and around each contact for pressure-tight construction.	*Receptacle* (Panel) — *Plug* (Cable) CR5-2S — CR5-2P (Standard type, pin contacts in plug) CR5-2P-R — CR5-2S-R (Reversed type, pin contacts in receptacle) (5 contacts #20 AWG) (2 contacts #18 AWG)
MINIATURE For Aircraft, Instruments and Portable Equipment Light weight, Polarized, Self-aligning with special guide pins. Rack, Panel or Cable mounted with Hood and Cable strain relief.	*Receptacle* — *Plug* MRE7S-G — MRE7P-G MRE8S-G — MRE8P-G MRE9S-G — MRE9P-G MRE12-2S-G — MRE12-2P-G MRE14S-G — MRE14P-G MRE18S-G — MRE18P-G MRE20S-G — MRE20P-G MRE21S-G — MRE21P-G MRE26S-G — MRE26P-G MRE34S-G — MRE34P-G MRE41S-G — MRE41P-G MRE50S-G — MRE50P-G MRE75S-G — MRE75P-G

SERIES "B"

2/3 ACTUAL SIZE

SERIES "SA"



2/3 ACTUAL SIZE

SERIES "HM"

ACTUAL SIZE

SERIES "QRE"

2/5 ACTUAL SIZE

SERIES "M"

4/5 ACTUAL SIZE

SERIES "F"

2/5 ACTUAL SIZE

DESCRIPTION	Types Available
MINIATURE INSERT IN SPECIAL SHELL Aluminum die-cast shells available in ⅞″ and 1-7/32″ dia. with bayonet locking for quick engage and disengage. Shells have synthetic rubber gaskets. Flanges permit mounting of receptacle in panel or housing and special gland construction provides cable entry in plug.	*Receptacle* (Panel) — *Plug* (Cable) B12S — B12P B14S — B14P B24S — B24P (Standard type, pin contacts in plug.) B12P-R — B12S-R B14P-R — B14S-R B24P-R — B24S-R (Reversed type, pin contacts in receptacle.) (Figures in above Code Nos. indicate number of contacts.)
LIGHTWEIGHT AIRCRAFT SMALL Polarized: Rack, Panel or Cable mounted—with Hood or Clamp and Cable strain relief	*Receptacle* — *Plug* SA7S — SA7P SA10S — SA10P SA15S — SA15P SA18S — SA18P (Figures in above Code Nos. indicate number of contacts.)
HERMETIC PLUG (Round Hole) Special contacts fused in glass into special base plate provided for soldering into a round hole in an hermetically sealed housing or bulkhead. Used with Standard "M" Receptacle.	*Plug* HM4P HM5P HM7P (Used with Standard M4S, M5S or M7S Receptacles)
QUICK-DISCONNECTING SELF-ALIGNING Spring-loaded contacts for ease in separation. Self-aligning with special guide pins. Rack, Panel or Cable mounted with Hood and Cable strain relief.	*Receptacle* — *Plug* QRE6S — QRE6P QRE12S — QRE12P QRE18S — QRE18P QRE24S — QRE24P QRE34S — QRE34P QRE208S — QRE208P AQRE12S — AQRE12P MAQRE18S — MAQRE18P
MINIATURE For Aircraft, Instruments and Portable Equipment Light weight, Polarized, Locking Ring. Panel or Cable mounted with Hood and Cable strain relief.	*Receptacle* — *Plug* SM1S — SM1P SM2S — SM2P M4S — M4P M5S — M5P PM6S — PM6P M7S — M7P M9S — M9P M12S — M12P M48S — M48P (Figures in above Code Nos. indicate number of contacts.)
SPECIAL CONNECTORS Unique design permits the use of two sizes of wire — #20 and #14 AWG—and assures uniform electrical and mating characteristics. Light-weight, polarized and panel mounted, these connectors are available with or without guides.	*Receptacle* — *Plug* F5S-G — F5P-G F2S-8P-G — F2P-8S-G F9S-9P-G — F9P-9S-G (Figures in above Code Nos. indicate number of contacts. First figure for #20 AWG, second figure for #14 AWG.)

MANY FEATURES are covered by our Pat. No.'s 161900, 162795, 2411861, 2466370, 2513080, 2526325, 2532538. Other Pats. Pend.

MONOBLOC* CONSTRUCTION eliminates unnecessary creepage paths and reduces possibility of moisture and dust pockets and provides stronger molded parts.

MOLDED MELAMINE body parts insure greater mechanical strength and high dielectric and arc resistance.

PRECISION MACHINED CONTACTS are gold plated over silver for consistent electrical conductivity, prevention of corrosion and ease in soldering.

Connectors & components meet applicable government specifications.

Write or telephone our Engineering Department for information on the above or other connectors—or for consultation on difficult connector problems. Many other standard and special types available.

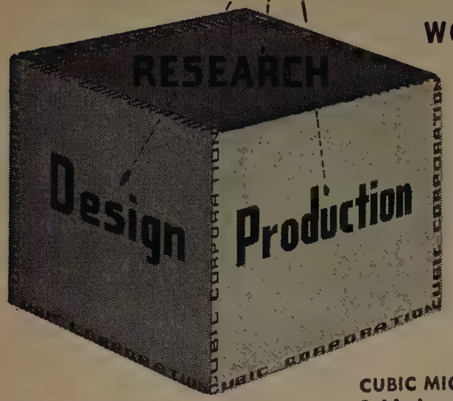
*Trade Mark

West Coast Branch:
1729 WILSHIRE
BOULEVARD
SANTA MONICA,
CALIFORNIA

WINCHESTER ELECTRONICS INCORPORATED

GLENBROOK, CONNECTICUT, U.S.A.

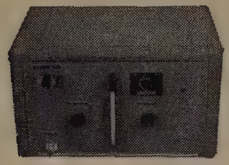
CUBIC'S 3 SIDED COVERAGE



PROVIDES YOU WITH THE WORLD'S FINEST PRECISION

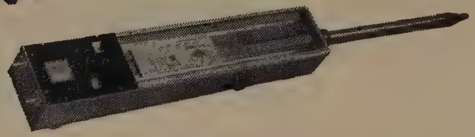
- MICROWAVE & RADAR COMPONENTS
- ELECTRONIC INSTRUMENTS & TEST EQUIPMENT

CUBIC MICROWAVE ENGINEERS—specialists in the field since the inception of Radar in World War II—start with electronic problems and ideas, and convert them into the most accurate precision-built electronic instruments and equipment! We welcome inquiries—not only in connection with our rapidly developing list of products—as represented below—but on ideas, problems, or design of microwave assemblies of your own specification you may want developed and produced.



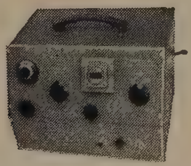
MICROWAVE CALORIMETRIC WATTMETER

portable . . . for lab and field use . . . to measure absolute microwave power.
Frequency Range: 2600 MC to 26500 MC
Max. VSWR: 1.1
Max. Peak Power: 600 KW



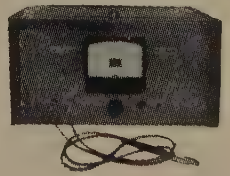
COAXIAL CALORIMETRIC WATTMETER

Frequency Range: 200 MC to 3000 MC—Max. VSWR: 1.5 over range—Max. Peak Power: 1⅝'' Coaxial rating



MICROWAVE (X-BAND) PULSE MEASURING WATTMETER

for measuring peak power of microwave pulses from signal generators or radar systems.



ELECTRONIC DIRECT-READING PHASE METER

Frequency Range: 20 to 50,000 cycles
0-360 degrees

Shown at left are a few of our standard microwave components available as catalog items. Special purpose wave guide assemblies designed to customer's specs can also be produced.

CUBIC CORPORATION
SCOTT & CANON STS.
SAN DIEGO 6
CALIFORNIA

Devoted Exclusively to Electronics & Electronic Equipment

What to see at the Radio Engineering Show

(Continued from page 132A)

Chester Cable Corp.
Chester, N.Y.
4-704

Electrical wires and cables.

Chicago Telephone Supply Corp.
Elkhart, Ind. 4-608

For your military and commercial requirements a complete line of wirewound and carbon composition variable resistors will be shown. JAN-R-19, JAN-R-94 and other military types of variable resistors available for immediate delivery from stock will also be displayed.

Ciba Company, Inc., New York 14, N.Y. 4-909
Resins and adhesives of interest to the electronics industry—Araldite, Redux, Cibanite.

Harold B. Jones Div.
Cinch Mfg. Corp.
Chicago 24, Ill.
2-505 & 506

Electrical Connecting Devices.

C. P. Clare & Co. New York 17, N.Y. 2-306
Relays for electric, electronic, and industrial uses. Hermatically sealed relays. Stepping switches. Lever keys and push keys.

Clarostat Mfg. Co., Inc., Dover, N.H. 2-507 & 508
Precision Potentiometers—Miniature Composition Potentiometers — Wire-Wound Miniature Potentiometers. Resistors and Resistance Devices for Communications—Radar—Aircraft—Television and Radio and Home Appliances.

Cleveland Container Co.
Cleveland 11, Ohio

Clevelite the paper base laminated phenolic tube—various grades and fabrications—also "Torkrite" the answer to stripping and torque problems encountered in coil forms requiring the use of iron cores or metal inserts. 2-309

Sigmund Cohn Corp.
Mount Vernon, N.Y.
2-214

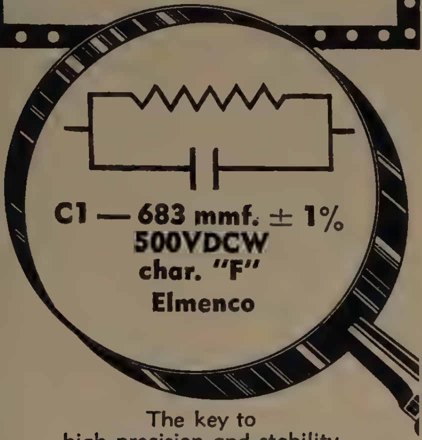
Precious metal products, very small wires, gold plated wires, and enameled wires; gold and rhodium plating solutions.

(Continued on page 136A)

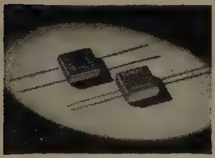
PRECISION

IS THE WATCHWORD TODAY IN ELECTRONICS

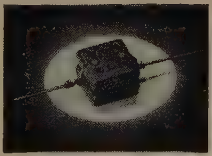
. . . as technological advancements call for circuits of increasing accuracy and dependability!



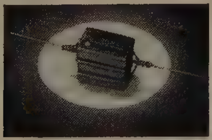
The key to high precision and stability lies in proper selection of mica capacitors, made possible through our ability to provide ANY CAPACITY at ANY TOLERANCE with the highest characteristics within the ranges specified for molded mica capacitors.



SINGLE UP TO 15000 MMF



DUAL UP TO 30000 MMF



TRIPLE UP TO 45000 MMF

Any Capacity
Any Tolerance (to ± 0.5%)
JAN Characteristic "F" or Better
for Most Capacity Values.

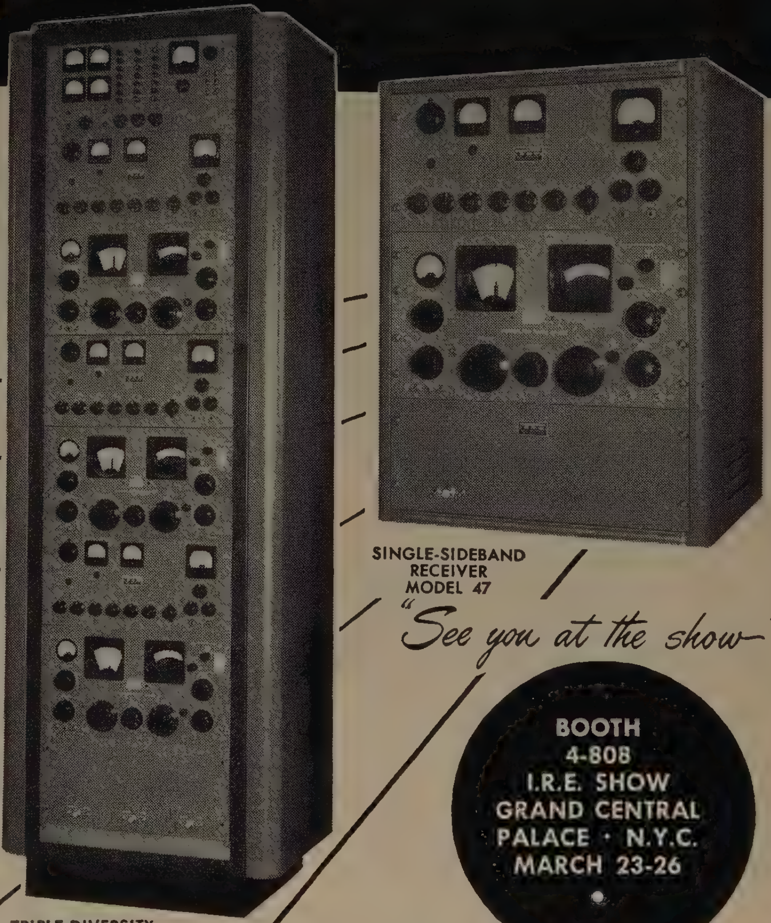
All capacitors are ELMENCO and are manufactured in accordance with JAN-C-5 specifications. Known the world over for their reliability under all operating conditions, ELMENCO CAPACITORS are chosen by manufacturers requiring the highest quality components for their products.

Write for our free descriptive catalog and for information regarding your special product requirements.

ARCO ELECTRONICS INC.
103 LAFAYETTE ST., N. Y. 13, N. Y.

WE WILL BE AT BOOTH 4-308 AT THE I.R.E. SHOW

TODAY'S COMMUNICATION TREND IS TOWARD SINGLE-SIDEBAND



SINGLE-SIDEBAND RECEIVER MODEL 47

TRIPLE-DIVERSITY SINGLE-SIDEBAND MODEL 155

"See you at the show"

BOOTH 4-808
I.R.E. SHOW
GRAND CENTRAL PALACE · N.Y.C.
MARCH 23-26

The Crosby Triple-Diversity Single-Sideband Receiver, Model 155 (left), and Single-Sideband Receiver, Model 47 (right), provides the ultimate in performance for long-range radio reception. Receives all forms of double and single-sideband transmission including reduced-carrier single-sideband transmission and amplitude-modulation or phase-modulation transmission.

For program, voice, tone-multiplex and twin-channel operation: optimum performance in rejecting interference; protected against jamming; precision performance.

The equipment is approximately one-third the size, weight and cost of single-sideband receiving equipment heretofore available, yet provides a new standard of performance under severe conditions of interference and fading.

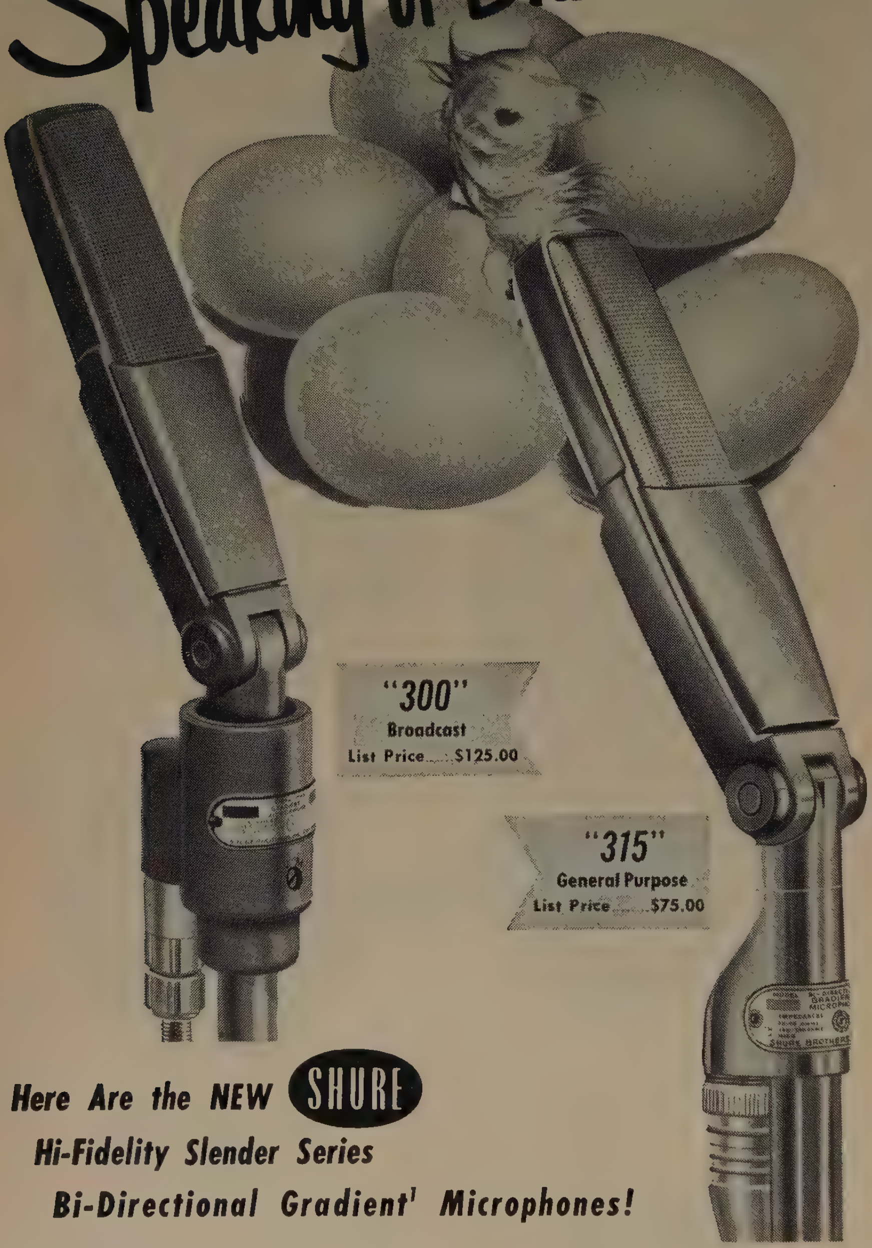
The complete triple-diversity equipment, Model 155, is contained in one standard-size cabinet rack. The Model 47 single-sideband receiver requires only 28" of vertical panel space.

- ***Send for our descriptive booklets on this equipment, giving complete details.***

CROSBY

CROSBY LABORATORIES, Inc.
ROBBINS LANE • HICKSVILLE, N. Y.

Speaking of Brand New!



Here Are the NEW SHURE Hi-Fidelity Slender Series Bi-Directional Gradient[1] Microphones!

● **These microphones** outperform all other "slender" microphones—because of their advanced acoustical, electrical and mechanical features. Both models permit greater performer freedom (performers can stand at a 73% greater distance from the microphone!) The "300" and "315" will pick up voice and music from front and back—yet discriminate against unwanted noises from the sides. They reduce reverberation and the pickup of distracting random noises by 66%!

● **Model "300" Broadcast** is specially designed to meet the exacting requirements of TV, radio broadcasting, and recording. It has a special "Grayje" subdued, non-reflecting finish that blends into the background, gives the spotlight to the performer. Has a "Voice-Music" switch for perfect reproduction of the soloist working at close range, or for the distant instruments of the orchestra. Special vibration-isolation unit eliminates "handling" noises and the pickup of floor vibrations. Model "315" General Purpose is similar in size, design and technical features to the Model "300." It is finished in rich, soft chrome—ideal for those public address applications where its streamlined design and beauty lend prestige to any setting in which it is used.

IMPEDANCE TABLE	OUTPUT LEVEL
L—35-50 ohms	59.5 db below 1 Milliwatt per 10 microbar signal
M—150-250 ohms	60.0 db below 1 Milliwatt per 10 microbar signal
H—High	59.5 db below 1 volt per microbar

[1] Shure Patents Pending

SHURE BROTHERS, Inc. ★ Manufacturers of Microphones and Acoustic Devices
225 West Huron Street, Chicago 10, Illinois • Cable Address: SHUREMICRO

What to see at the Radio Engineering Show

(Continued from page 134A)

Coil Winding Equipment Co.
Oyster Bay, L.I., N.Y.
3-521
WX WINDING MACHINE

Continuously Variable Gain for Lattice Winding. Continuously Variable Wire Spacing on Bobbons, Transformers, & Single Layer Coils.

Coil Winding Equipment Co., Oyster Bay, L.I., N.Y. 3-521
Showing the latest developments in equipment for the winding of coils—Equipment for Laboratory, Schools, and Production. Engineering help on special problems. Special designs for winding stator coils, self-supporting layer wound coils, and coils with cotton inter-weaving. Unique cam design provides variable throw without back-lash at high speeds.

Collins Radio Co.
Cedar Rapids, Iowa
1-801 & 806
Transmitting, Communications and Electronic Equipment.

Communication Measurements Lab., Inc.
Plainfield, N.J.
4-418
Electronic Generators, Power Supplies, Rotobridge, Stroboscope, Megohmmeter and Printed Circuit Package.

Condenser Products Co., Chicago 26, Ill. 2-112
Plasticon Capacitors.

Connecticut Telephone & Electric Corp., Meridien, Conn. 3-307A
Signal generator covering the complete rage of VHF to UHF frequencies. Hand microphone. Miscellaneous head set and hand sets. Miniature motors. Carrier equipment consisting of ringer filter units and voice frequencies line unit. Decibel meter.

Consolidated Engineering Corp., Pasadena 16, Calif. 4-413 & 415
"Sadic" data processing equipment, analog to digital converters, recording oscillographs, vibration meters, pickups and transducers, leak detector (mass spectrometer type), micromanometer, vacuum gauge, and other electronic analytical instruments.

Consolidated Vacuum Corp., Rochester 3, N.Y. 2-408 & 409
Featuring new 16 head high speed rotary exhaust machine for electron tubes; small compact, semi-automatic frequency crystal coater; 10-Port Vacuum Manifold System for leak testing and backfilling hermetics. Also expanded range Philips vacuum gauge, halogen sensitive leak detector, plus accessory high vacuum equipment items.

L. L. Constantin & Co., Lodi, N.J. 4-422
Manufacturing Engineers specializing in all varieties of metal-to-glass vacuum seals. Included in the complete line are crystal holders, multi-pin headers, single terminals, single and seals, multi-pin con plugs, vacuum coating equipment and precision parts.

(Continued on page 140A)

EXPANDING PRODUCTION

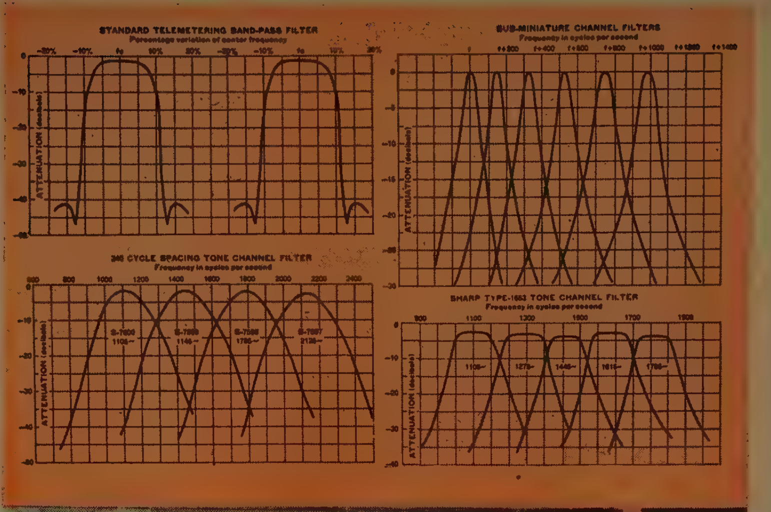
in Toroids & Filters

At every management meeting in Burnell & Company there is an unseen but highly respected visitor. He is the spectre of all our customers and his opinions carry weight. Recently he suggested that in addition to our other expansion measures that we must find a way to improve deliveries for emergency and special sample orders. Our solution is certainly not original but no less effective.

Burnell & Company's new sample department has been able to produce audio filters from proverbial 'scratch' to the customer's waiting hands in as little as ten days!

Frankly, this cannot always be accomplished but our average has been ranging between three to four weeks for emergency samples and four to six weeks for regular prototypes instead of the former twelve weeks of the pre-sample department days.

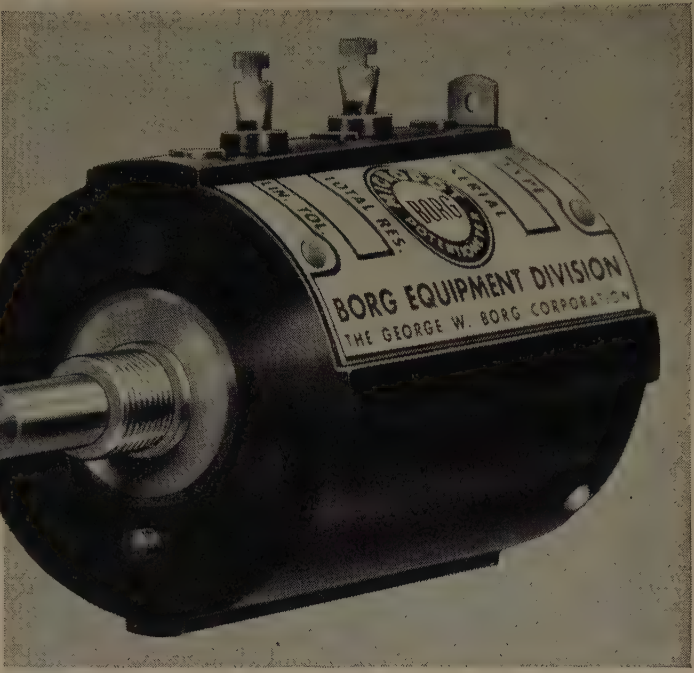
Adding this to our new winding department and our new testing and finishing departments the sum total has been a *still* better product at a better delivery than ever before.



EXCLUSIVE MANUFACTURERS OF COMMUNICATIONS NETWORK COMPONENTS

Burnell & Company
YONKERS 2, NEW YORK
CABLE ADDRESS "BURNELL"

THE HIGH-PRECISION LINEAR POTENTIOMETER



MICROPOT

precision ten-turn potentiometer

BORG MICROPOT TEN-TURN POTENTIOMETER: Built to fit the specifications of control system engineers and designers . . . constructed with Micro accuracy for precise voltage adjustments . . . featuring an assembly scientifically designed, machined, assembled and automatically machine tested for linearity of ±0.1% and 0.05%, *zero-based.* MICROPOTS ARE AVAILABLE IN 1.15 to 3 OHM and 30 to 250,000 OHM RANGES FOR IMMEDIATE SHIPMENT.

BORG MICRODIAL: Two concentrically mounted dials: one for counting increments of each turn and the other for counting turns . . . delivered completely assembled with dials synchronized. Outstanding features include smooth, uniform action . . . no backlash between incremental dial and potentiometer contact . . . less wear, only one moving part aside from the two dials . . . contact position indicated to an indexed accuracy of 1 part in 1,000.

SEE US AT BOOTH 2-517 AT THE I. R. E. SHOW, NEW YORK

BORG MICRODIAL 746-A

A precision ten-turn indicating dial assembly. Has screw locking device on operating knob.

BORG MICRODIAL 746-B

Same as 746-A but has knurled locking screw mounted externally to operating knob.

MICRODIAL BORG MICROPOT BORG

BORG EQUIPMENT DIVISION

THE GEORGE W. BORG CORPORATION

Janesville • Wisconsin

What to see at the Radio Engineering Show

(Continued from page 136A)

VACUUM SEALED CRYSTAL HOLDERS

METAL to GLASS VACUUM SEALS

MULTI-PIN HEADERS | SINGLE TERMINALS

MULTI-PIN CON PLUGS | SINGLE END SEALS

L. L. Constantin & Co.

booth 4-422
Grand Central
Palace

Continental Carbon, Inc., Cleveland 11, Ohio 2-133
"Nobleloy" Precision Metal Film Resistors; Composition Resistors; Low Power Wire Wound Resistors; Auto Radio Capacitors and Suppressors; Oil Burner Suppressors.

Continental Connectors 4-125
Continental Connectors, by DeJur-Amsco Corporation, Long Island City, displays its complete line of precision multi-contact connectors, stand-off terminals, and terminal blocks. Engineers will be present at the booth to discuss specific problems relating to connector applications. Engineering bulletins will be available.

Continental Diamond Fibre Co., Newark 48, Del. 4-603
Manufacturing and fabricating of electrical insulation, molded and laminated plastics.

Copperweld Steel Co., Flexo Wire Division, Glassport, Pa. 4-911
Copperweld Steel Company's exhibit in booth No. 4-911 depicts the making of Copperweld Wire by the unique Molten-Welding process. Samples of Copperweld Fine Wires will be featured together with Copperweld Radio and Television Products such as ground rods and clamps, antenna wire, guy wire, and grounding wire.

Cornell-Dubilier Electric Corp.

1-807 & 808

Capacitors, antennas, rotators, vibrators converters, etc.

Corning Glass Works, Corning, N.Y. 1-416-418 & 420
Glass bulbs for applications in all fields of electronics: metallized glassware for radio and television components.

The R. W. Cramer Co., Inc., Centerbrook, Conn. 3-504 & 505
Synchronous timing motors, Interval timers, time delay relays, cycle timers, percentage timers, Hermetically sealed aircraft type time delay relays, reclosing relays, running time meters, and miscellaneous electric timing devices.

Crest Labs., Inc., New York, N.Y. 4-128
See: Microtran Co.

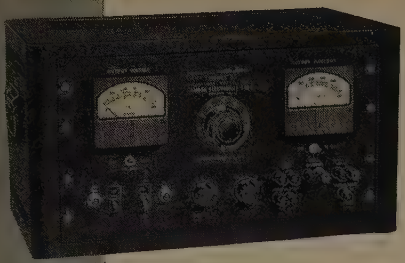
Crosby Laboratories, Inc.
Hicksville, L.I., N.Y.

4-808

Single Sideband and Exalted-Carrier Receivers.
FM Multiplex Equipment
Stereophonic Sound Equipment
Phase Modulator
Research & Development Facilities

(Continued on page 142A)

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES



BENCH MODEL 50

STABLE • DEPENDABLE • MODERATELY PRICED

- INPUT: 105-125 VAC, 50-60c
- OUTPUT #1: 0-500 VDC at 500 ma regulated
- OUTPUT #2: 0-50 VDC, 0-200 VDC Bias Output.
- OUTPUT #3: 6.3 VAC at 5A unregulated
- OUTPUT #4: 6.3 VAC at 5A unregulated
- RIPPLE OUTPUT: Less than 8 millivolts rms

ALSO AVAILABLE STANDARD RACK MOUNTING
MODEL 50-R
PANEL SIZE 10½" x 19"
DEPTH 14¼"

For complete information write for Bulletin 50S

LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES

IRE
IRE SHOW
MARCH 23-26 1953
GRAND CENTRAL PALACE
NEW YORK CITY

BOOTH 3-501
•
VISIT OUR DISPLAY OF CURRENT AND NEW MODELS

LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES

BENCH MODEL 25

STABLE • DEPENDABLE • MODERATELY PRICED

- INPUT: 105 to 125 VAC, 50-60 cy
- OUTPUT #1: 200 to 325 Volts DC at 100 ma regulated
- OUTPUT #2: 6.3 Volts AC CT at 3A unregulated
- RIPPLE OUTPUT: Less than 10 millivolts rms

WIDTH 14"
DEPTH 6"
HEIGHT 8"
WT: 17 LBS.

For complete information write for Bulletin N-5S

LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES

RACK MODEL 32

STABLE • DEPENDABLE • MODERATELY PRICED

- INPUT: 105 to 125 VAC, 50-60 cy
- OUTPUT #1: 200 to 325 VDC at 300 ma regulated
- OUTPUT #2: 6.3 Volts AC CT at 5A unregulated
- OUTPUT #3: 6.3 Volts AC CT at 5A unregulated
- RIPPLE OUTPUT: Less than 10 millivolts rms

STANDARD RACK MOUNTING
PANEL SIZE 10½" x 19"
DEPTH 9"
WEIGHT 38 LBS

For complete information write for Bulletin N-2S

LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES

RACK MODEL 28

STABLE • DEPENDABLE • MODERATELY PRICED

- INPUT: 105 to 125 VAC, 50-60 cy
- OUTPUT #1: 200 to 325 Volts DC at 100 ma regulated
- OUTPUT #2: 6.3 Volts AC CT at 3A unregulated
- RIPPLE OUTPUT: Less than 10 millivolts rms

MODEL 28 STANDARD RACK MOUNTING
PANEL SIZE 5¼" x 19"
WEIGHT 16 LBS.

For complete information write for Bulletin N-8S

LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES

RACK MODEL 33

STABLE • DEPENDABLE • MODERATELY PRICED

- INPUT: 105 to 125 VAC, 50-60 cy
- OUTPUT #1: 100 to 200 VDC at 300 ma regulated
- OUTPUT #2: 6.3 Volts AC CT at 5A unregulated
- OUTPUT #3: 6.3 Volts AC CT at 5A unregulated
- RIPPLE OUTPUT: Less than 10 millivolts rms

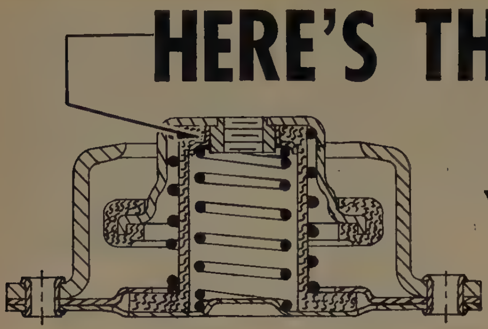
STANDARD RACK MOUNTING
PANEL SIZE 10½" x 19"
DEPTH 9"
WEIGHT 38 LBS

For complete information write for Bulletin N-3

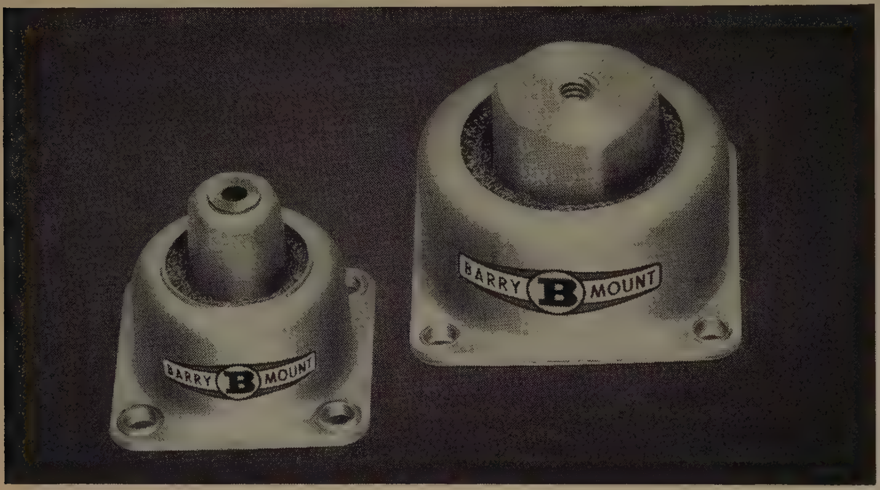
LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

SHOCK AND VIBRATION NEWS

HERE'S THE SECRET



... of a NEW wire-mesh isolator that won't change on the job!



The new Type 7630 and Type 7640 ALL-METL Barrymounts have been specifically designed to eliminate loss of efficiency due to damper packing. Previous wire-mesh unit vibration isolators exhibited a definite loss of damping efficiency after a period in actual service, because the wire-mesh damper tended to pack. These new unit Barrymounts have eliminated this difficulty, because the load-bearing spring returns the damper to its normal position on every cycle.

- Very light weight — helps you reduce the weight of mounted equipment.
- Hex top — simplifies your installation problems.
- High isolation efficiency — meets latest government specifications (JAN-C-172A, etc.) — gives your equipment maximum protection.
- Ruggedized — to meet the shock-test requirements of military specifications.
- Operates over a wide range of temperatures — ideal for guided-missile or jet installations.

Compare these unit isolators with any others — by making your own tests, or on the basis of full details contained in Barry Product Bulletin 531. Your free copy will be mailed on request.

See these new isolators in action, and discuss their applications with us, at the New York I.R.E. Show.

THE **BARRY** CORP.

718 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS

SALES REPRESENTATIVES IN

Atlanta Baltimore Chicago Cleveland Dallas Dayton Detroit Los Angeles Minneapolis New York Philadelphia Phoenix Rochester St. Louis San Francisco Seattle Toronto Washington

See Us in Booths 2-312, 313, IRE Show, March 23-26

What to see at the Radio Engineering Show

(Continued from page 140A)

Crucible Steel Co. of America, New York 17, N.Y. 4-203 & 204
Permanent magnets, castings.

Curtis Development & Mfg. Co.
Milwaukee 16, Wis.
3-514
Curtis Terminal Blocks:
For Every Purpose
Factory Assembled or
Kit Form.

DX Radio Products Co., Inc.
Chicago 47, Ill.
3-502
Toroid Coils, Speakers, TV Tuners Ion Traps, Crystals, RF & IF Transformers, Coil Assemblies, TV Deflection Yokes and TV Horizontal OutPut Transformers.

Dale Products, Inc.
Columbus, Nebr.
4-129
A Deposited Carbon Resistor Furnace in operation at our Booth. Also displaying Miniature Precision Power Resistors in wattage ranges from 2 watts to 250 watts with temperatures coefficient of less than 0.00002/°C and accuracy as close as .1%—Also a complete showing of precision deposited carbon resistors.

The Daven Co.
191 Central Ave.
Newark 4, N.J.
1-118, 119
Audio, Video, and R. F. Attenuators, Precision Wire Wound Resistors, Rotary Switches, Vacuum-Tube Voltmeters, Distortion Meters, Transmission Measuring Sets, Power Output Meters, Laboratory Test Equipment.

Bryan Davis Publishing Co., Inc., New York 17, New York 2-201
Magazine and books. "Service."

Decade Instrument Co.
Caldwell, N.J.
4-905
Frequency converters for use with frequency counters—"Decaviders," Decade - Switched Sweeping Oscillators—"Deca-Sweeps," and Decade-Switched Oscillators—"Decalators."

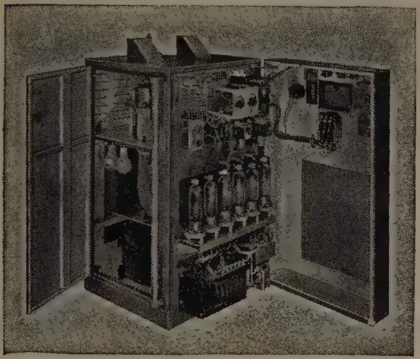
DeJur-Amsco Corporation, Long Island City, N.Y. 4-125
Precision potentiometers, meters, rheostats, and other electronic equipment designed to meet the exacting requirements of contemporary electronic needs. Engineers will be present at the booth to discuss specific application problems relative to all DeJur products. Complete technical literature available at booth.

(Continued on page 144A)

PANELS, LIDS, DOORS MADE RF-TIGHT BY LOW COST METHOD

Electronic Weatherstripping, made of knitted wire mesh compressed to required sizes and shapes, effectively "shields" these openings against RF leakage just as weatherstrips seal doors and windows.

Openings such as these are necessary for operating and servicing the electronic equipment housed in the metal cabinet. Yet these same openings destroy the full shielding efficiency which an "unbroken" metal container would otherwise provide. Careful machining of mating surfaces at these openings is an obvious answer. But such work is expensive, and the initial close fit is often destroyed by repeated openings and closings, by warping of the lid or door and by corrosion of the mating surfaces. Numerous latches, screws, bolts and other fasteners, closely spaced, will help keep these joints RF tight, but they are a time consuming nuisance whenever the cabinet must be opened and closed, and they are also expensive to purchase and install.

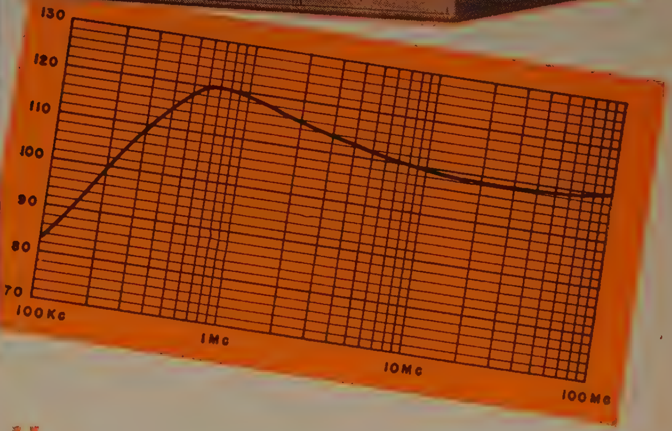

"Thermatron built by Radio Receptor Co., Inc."

Metex Electronic strips and gaskets eliminate these objections. Being made of metal, they are conductive; and being knitted they are resilient and conform to normal surface irregularities. They actually "block" the otherwise leaky openings with a gasket of flexible metal, and make the cabinet as effective a conductive shield as if the openings had never been made.

Metex electronic strips and gaskets are easy to install. Not only are they inexpensive, but their use may well save more than their cost by eliminating many operations that would otherwise be necessary. They are available in different shapes, dimensions and resiliencies to meet the varied requirements of specific electronic applications and can be made of metals or alloys selected to meet actual or anticipated corrosive conditions.

A bulletin giving detailed information is available on request from the manufacturer, Metal Textile Corporation, East First Avenue, Roselle, N. J.

NOW A Solid
SHIELDED ENCLOSURE
for Suppressing R-F Interference



Here it is! The answer to the electrical engineer's increasing demand for a copper sheet enclosure to suppress radio interference.

Developed by RFI, it was later subjected to comprehensive tests by an independent laboratory, the Hopkins Engineering Co. of Washington, D.C. This firm transported a typical unit to six different high-power transmitting stations. At each station, the Uniform Field Method of testing was employed. Results are shown conservatively plotted above. In actual use, even greater attenuation may be expected.

Standard RFI enclosures are now available in eight easily-installed sizes ranging from 6x8x8 to 15x10x8. Various services such as light, water, power, gas, and transmission lines can be brought into the room. Full details are available in our free bulletin. Write for your copy today.

RFI
SHIELDED ENCLOSURES, Inc.
3634 N. Lawrence Street Philadelphia 40, Pa.

During the I. R. E. Show see us at the Belmont Plaza Hotel

NRK

Microwave Assemblies, Radar Components, and Precision Instruments . . . manufactured to your Blueprints and Specifications.

See us at
BOOTH 2-212
Radio Engineering Show
MARCH 23-26
Grand Central Palace
New York City

N. R. K. MFG. & ENGINEERING CO.
4601 WEST ADDISON STREET • CHICAGO 41, ILLINOIS

BOND AXIAL LEAD RESISTORS

Bond ELECTRONICS CORP.

This is it! Truly non-corrosive joints, precision wire wound. Complete protection from chassis or mounting surfaces, and made to all standard tolerances in a wide range of alloys to meet requirements of varying resistance values. Insist on Bond . . . your bond of perfect performance!

Size Range Of The New Bond Axial Lead resistors:

Toroidal
Industrial
Solenoid
Bobbin
Radio
Television
Coils

Made to all standard tolerances and precision wound in a wide range of alloys.

BOND TYPE	OVER-ALL LENGTH INCHES	OVER-ALL DIA. INCHES	RESISTANCE RANGE		POWER RATING		JAN. EQUIV. TYPE
			MIN. OHMS	MAX. MEG OHMS	COMM.	JAN.	
1515	11/16	3/8	1.0	0.42	1/3	1/4	RB51
1516	1 1/16	3/8	1.0	0.85	1/2	1/4	RB51
1517	1 5/16	3/8	1.0	1.25	1.0		
201	1 1/16	7/16	1.0	1.15	3/4	1/4	RB51

Note: All Bond Resistors are impregnated to meet JAN-R-93 specifications.

Send me free catalog and engineering bulletin.

Name...

Address...

City..................................State........

BOND
ELECTRONICS CORPORATION
60 SPRINGFIELD AVENUE
SPRINGFIELD, NEW JERSEY

What to see at the Radio Engineering Show

(Continued from page 142A)

DeJur-Amsco Corp.
Long Island City 1, N.Y.
4-125

DeJur potentiometers, rheostats, panel instruments CONTINENTAL, connectors.

Tobe Deutschmann Corp., Norwood, Mass. 3-520
Capacitors, metallized paper, oil and wax impregnated paper, molded paper, high temperature, Filters: Radio TV-Noise suppression, low pass, high pass, band pass, audio. Special products, pulse forming networks, pulse capacitors, delay lines, toroidal coils.

Dialight Corp.,
Brooklyn 37, N.Y.
1-504

Sub-miniature indicator lights in non-dimmer, dimmer (complete or semi-blackout), polaroid and light shield types. Also featuring the New subminiature Press-to-test light. Plastic plate edge lighting assemblies with a choice of filter colors. Warning, signal, indicator, pilot light assemblies for neon and incandescent lamps.

Diamond Mfg. Corp., Wakefield, Mass. 4-309
RF coaxial cable connectors and associates components.

Digital Instrument Co., Inc., Coral Gables, Fla. 4-111
Digital decade counters, time base generators, preset counters, cycling counters, nuclear scalers, industrial counters.

Wilbur B. Driver Co.
Newark 4, N.J.
2-103, 104

Filament Grid Wire
Carbonized Nickel for Anodes
Wire & Ribbon Resistors
Glass to Metal Seals

Wilbur B. Driver Co., Newark 4, N.J. 2-103 & 104
Melters and Manufacturers of Alloys for the following electronic applications: 1-Filament 2-Grid Wire 3-Carbonized Nickel for Anodes, Wire and Ribbon 4-Resistors 5-Glass to Metal Seals, Alloy Names; Evanohm, Tophet, Cupron, Radiocard, Sylvaloy, Modified Hilo, Cobanic, Rodar, Nilstain, Balco, Manganin, #60, #90, #180 Alloy.

Allen B. Du Mont
Laboratories, Inc.
Instrument Division
760 Bloomfield Avenue
Clifton, N.J.
1-212, 213

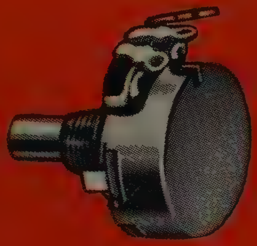
General Purpose C-R Voltmeter; General Purpose Dualbeam Oscillograph; High-voltage, high frequency C-R Oscillograph; C-R oscillograph accessories and oscillograph-record cameras; tight-tolerance C-R tubes; special C-R tubes; new photomultiplier tubes.

(Continued on page 150A)

COMPLETE MILITARY LINE

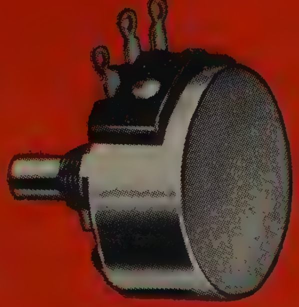
Immediate delivery from stock on 189 types including JAN-R-94 and JAN-R-19 types of variable resistors.

NEW 38-PAGE ILLUSTRATED CATALOG—
Describes Electrical and Mechanical characteristics, Special Features and Constructions of a complete line of variable resistors for military and civilian use. Includes dimensional drawings of each resistor. *Write today for your copy.*

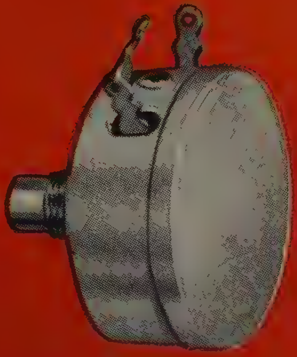


TYPE 45, (JAN-R-94, Type RV2)
1/4 watt, 15/16″ diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

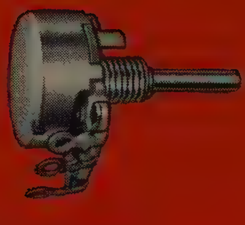
TYPE 35, (JAN-R-94, Type RV3)
1/2 watt, 1 1/8″ diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.



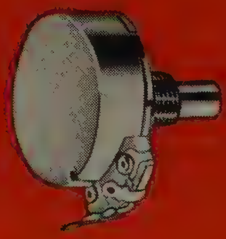
TYPE 252, (JAN-R-19, Type RA20)
2 watt, 1 17/64″ diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



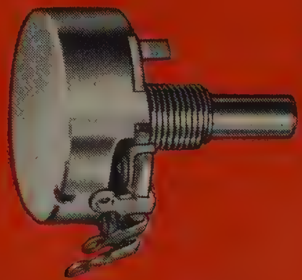
TYPE 25, (JAN-R-19, Type RA30)
(May also be used as Type RA25)
4 watt, 1 17/32″ diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



TYPE 65, (Miniaturized)
1/2 watt 70°C, 3/4″ diameter miniaturized variable composition resistor.



TYPE 90
1 watt 70°C, 15/16″ diameter variable composition resistor. Attached switch can be supplied. Also available in concentric shaft tandem construction.



TYPE 95, (JAN-R-94, Type RV4)
2 watt 70°C, 1 1/8″ diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

See the complete CTS military and civilian lines of variable resistors at the

IRE SHOW

Grand Central Palace, New York City

MARCH 23-26, 1953

BOOTH 4-608

UNPRECEDENTED PERFORMANCE CHARACTERISTICS

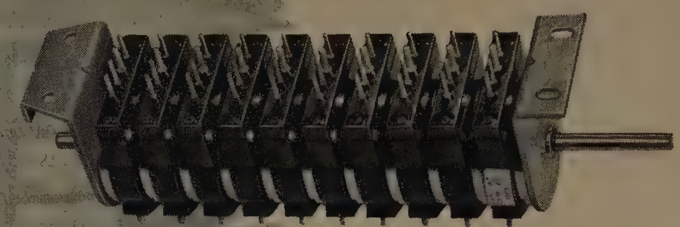
Specially designed for military communications equipment subject to extreme temperature and humidity ranges. -55°C to +150°C...aridity to saturation.

CTS

CHICAGO TELEPHONE SUPPLY
Corporation

ecision Mass Production of Variable Resistors

maintenance and replacement are simplified with Fairchild



plug-in potentiometers

These plug-in type ganged potentiometers are another excellent example of Fairchild's service in meeting the special requirements of customers. The problem was to provide ganged precision potentiometers that would simplify maintenance of airborne fire control equipment through quick and easy replacement. A series of packaged plug-in units like that shown was the answer.

An entire gang can be replaced in a few minutes because only the end mounting plates are fastened down. There are no wires to disconnect or solder. Test points are provided on the top of each potentiometer so it can be checked quickly.

Maximum rigidity of the gang is assured by mounting the individual units on a single shaft. These plug-in potentiometers have the same mechanical and electrical tolerances and performance characteristics that have made the Model 746 unit the first choice for many critical applications.

Use the coupon below to get full information.

FAIRCHILD
PRECISION POTENTIOMETERS

SEE THESE PLUG-IN UNITS AND OTHER INTERESTING DEVELOPMENTS IN PRECISION POTENTIOMETERS AT THE I. R. E. SHOW—BOOTH NOS. 2-405 AND 2-406

Potentiometer Division, Department 140-34H
Fairchild Camera and Instrument Corporation
Hicksville, Long Island, New York

Gentlemen:

Please send me complete information about Fairchild Precision Potentiometers and tell me how you might solve my potentiometer problems.

Name____________________

Position____________________

Company____________________

Address____________________

What to see at the Radio Engineering Show

(Continued from page 144A)

Allen B. Du Mont
Laboratories, Inc.
C-R Tube Division
750 Bloomfield Avenue
Clifton, N.J.
1-214, 215, 216

Latest developments in television picture tubes.

Allen B. Du Mont Labs., Inc., Instrument Div., Clifton, N.J. 1-212 & 213
Type 304-A General Purpose Cathode-ray Voltmeter; Type 322 General Purpose Dual-beam Oscillograph; Type 303-AH High-voltage, high frequency cathode-ray oscillograph; complete line of cathode-ray oscillograph accessories and oscillograph-record cameras; complete line of tight-tolerance cathode-ray tubes; special cathode-ray tubes; new photo-multiplier tubes.

Allen B. Du Mont Labs., Inc., Television Transmitter Div., Clifton, N.J. 1-208 & 211
Image Orthicon Camera and Mobile Mount Dolly; Portable Sync Generator; Du Mitter—(miniature closed circuit TV transmitter); Video Recorder; New UHF Antenna; New General Purpose Studio 17" Picture Monitor; Special Program Console—(with audio and video switcher in a model studio control room with master control equipment); Two Monochrome Scanners.

Allen B. Du Mont Lab., Inc., CRT Division, Clifton, N.J. 1-214, 215 & 216
Latest development in television picture tubes, products of the Cathode-ray Tube Division of Allen B. Du Mont Laboratories, Inc.

Dumont Electric Corp., New York 34, N.Y. 4-504
Tubular paper, dry electrolytic, metal clad, bathtub and upright capacitors. "Zero-Loss durene capacitors." "Thermo-film" dielectric capacitors.

Dyna-Labs., Inc.
Garden City, L.I., N.Y.
4-402

D-79 Gaussmeter — Magnetic earphones in various applications.

Hugh H. Eby, Inc.
Philadelphia 44, Pa.
2-101

New Sockets:—Rack and panel connectors: Printed Circuits:—vibrator sockets: Tuner components: Enlarged catalog: Do you have a component problem? Arrange to visit our engineers on duty during entire show.

Edin Co., Inc., Worcester 8, Mass. 4-421
Extended frequency Galvanometers with range from DC to 300 cps, Oscillograph Recorders with chart speeds ranging from .1 to 625 mms. per second, and JAN rack and panel type AC, DC and Carrier Amplifiers. Complete recording systems will also be featured with a selection of these instruments into multi-channel Consolettes.

SEE all four floors!

(Continued on page 152A)

improve your memory

with

andersen SOLID ultra-sonic DELAY LINES

In electronic computers, Andersen **SOLID** ultra-sonic delay lines are:

PHYSICALLY STABLE
ELECTRONICALLY DEPENDABLE

and **SOLID** delay lines mean minimum size and weight.

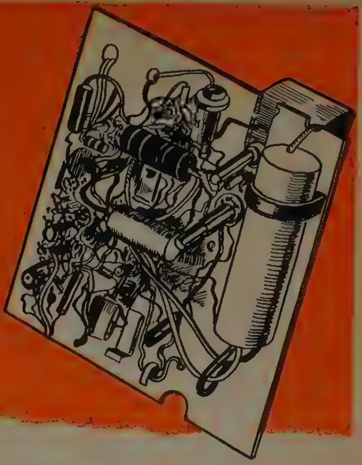
Spurious signals – 40db. or better.

Investigate Andersen **SOLID** ultra-sonic delay lines. Complete facilities for research and development.

andersen Laboratories INCORPORATED

37 Talcott Road
West Hartford 10, Conn.

Can You afford Spaghetti...

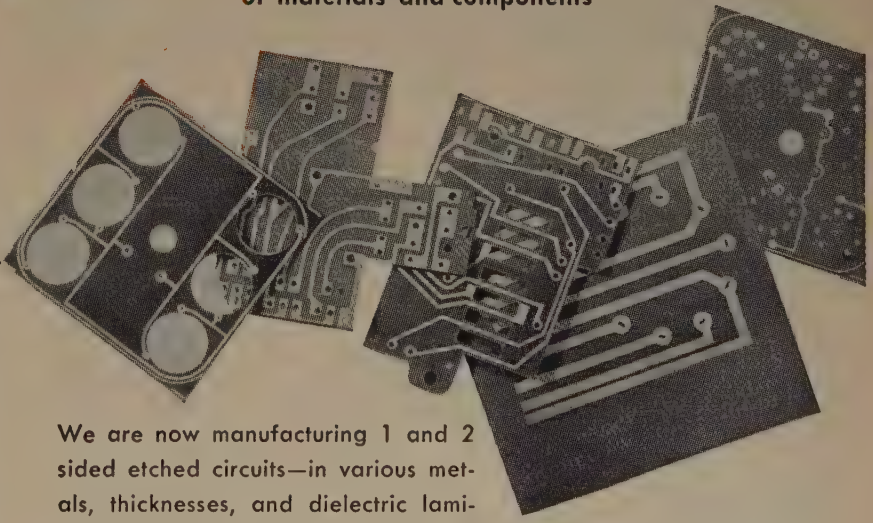


...WHEN ETCHED CIRCUITS NOW DO THE JOB

QUICKER — **Speed assembly, inspection, testing and servicing**

BETTER — **Save space, solve miniaturization problems, eliminate wiring errors and breaks**

AT LOWER COST — **Save labor costs, eliminate many tooling, fabrication, and assembly operations; reduce inventories of materials and components**



We are now manufacturing 1 and 2 sided etched circuits—in various metals, thicknesses, and dielectric laminates—for many leading electronic manufacturers, large and small.

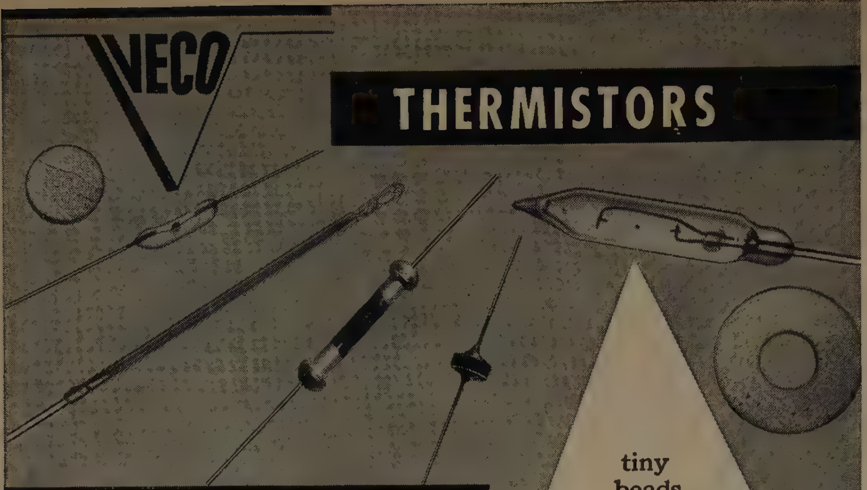
Tell us your current or future requirements and we will be glad to furnish samples and quotations on a strictly confidential basis. Our technical skill and modern production facilities are at your disposal.

Epco

Ask for Bulletin 26.

ETCHED PRODUCTS CORPORATION
3901 Queens Boulevard • Long Island City 1, N. Y.

ETCHED CIRCUITS • DIALS • NAME PLATES • PANELS • SCALES
ESCUTCHEONS • BEZELS AND OTHER DECORATIVE METAL TRIM



VECO

THERMISTORS

ANALYSIS CELLS

VECO Analysis Cells utilize VECO THERMISTORS. Analyzing and reference elements are *Sealed in Glass*—unaffected by corrosive gasses or liquids.

Available with any type of reference gas sealed in, if desired . . . new high-pressure seal withstands 1,000 psi . . . flow pipes easily connected . . .

VECO Analysis Cells provide new efficiency for instrumentation • gas analysis • combustion study — for chemical research, hospital and college laboratories, food storage protection — cells designed and manufactured to your specific requirements.

tiny beads solve problems in Measurement and Control of thermal, electronic and physical energy!

VECO Thermistors are made in the forms of Beads, Rods, Discs, and Washers — *Stocked* in a wide range of specific resistance values — or can be produced in quantity to *your* exacting specifications.

Distinguished from other sensing elements by extreme variations of electrical resistance with relatively minute thermal changes—approved and accepted by Government Agencies.

Victory's staff of engineers and physicists are ready to recommend the proper VECO Thermistor for • vacuum manometry • oscillator stabilization • temperature measurement • flow measurement • temperature compensation • surge protection • radar power measurement • volume limiting • gas analysis • temperature control • time delay • voltage regulation, as well as for any other new or unusual measurement or control application. Write today!

Visit Victory at the IRE Show
March 23-26,
Grand Central Palace, New York

A request on business stationery will bring the
VECO DATA BOOK
Thermistors
Analysis Cells
Combustion Analyzers
Varistors

Victory
ENGINEERING CORPORATION
Springfield Road, Union, New Jersey
Telephone: UNionville 2-7150

What to see at the Radio Engineering Show

(Continued from page 150A)

Thomas A. Edison, Inc.
Instrument Division
West Orange, New Jersey
4-714

Time Delay Relays, Sealed-in-Glass Thermostats, Sensitive Magnetic Relays, Electrical Resistance Bulbs.

Eimac
TUBES

The Power for TV

Eitel-McCullough, Inc.
SAN BRUNO, CALIFORNIA

Eitel-McCullough, Inc., San Bruno, Calif. 1-519
One of the world's largest manufacturers of transmitting tubes will have on display some of the more prominent tubes used in television transmitters: Tetrodes, triodes, klystrons for high power in VHF and UHF channels. Management and engineering representatives will be present and invite discussion of your tube applications.

Elastic Stop Nut Corp.
of America
Union, N.J.
4-209, 210

The ESNA booth will highlight the application potentialities of the Elastic Stop Nut and the Rollpin. Both fasteners are widely used throughout the electronic industry and sample sub-assemblies showing these applications will be displayed.
The Agastat, a compact, light-weight pneumatic time delay relay will also be displayed.

TUBE-SOCKETS
SHIELDS
VARICONS
(SENSATIONAL MINIATURE CONNECTORS)

BOOTH 4-313

ELCO CORPORATION
190 W. Glenwood · Philadelphia 40, Pa.

Electra Manufacturing Company, Kansas City 8, Mo. 4-217
Deposited Carbon Resistors.

Electric Regulator Corp., Norwalk, Conn. 4-118
Regohm electric circuit controllers and exhibits showing the application of the device to various equipments.

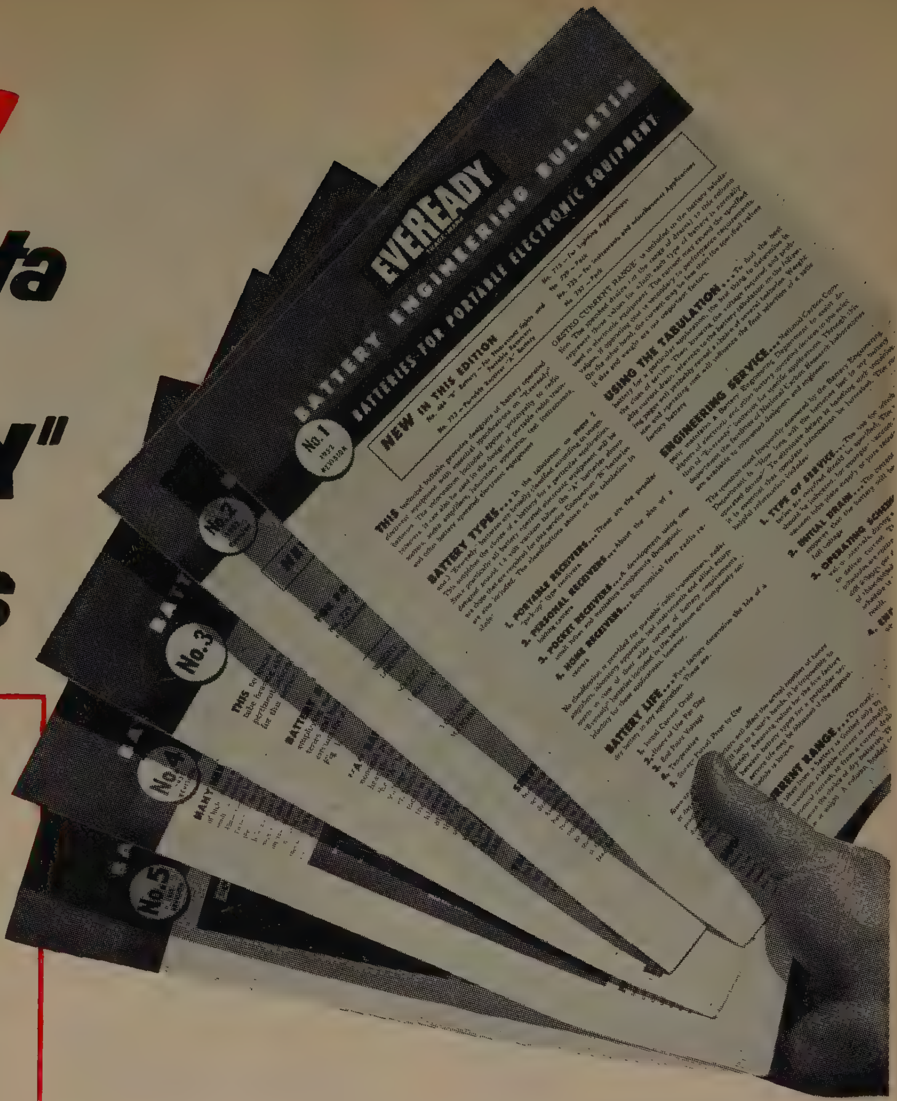
Electrical Industries
Div. of Amperex
Electronic Corp.
Newark 4, N.J.
2-314

Hermetically-sealed Terminals & Headers.

(Continued on page 154A)

FREE!

Latest Data on "EVEREADY" BRAND Batteries


EVEREADY
BATTERY ENGINEERING BULLETIN
BATTERIES FOR PORTABLE ELECTRONIC EQUIPMENT
No. 1
NEW IN THIS EDITION
No. 2
No. 3
No. 4
No. 5

- **Batteries for Portable Electronic Equipment**
- **"Mini-Max" "A-B" Packs for Portable and Home Receivers**
- **Batteries for Hearing Aids**
- **High Voltage Batteries**
- **Photoflash Batteries**

● NATIONAL CARBON COMPANY maintains a Battery Engineering Department to assist designers of electronic and other battery-operated devices in the selection of "Eveready" batteries for specific applications.

● Out of the Department's wide experience with all kinds of dry-battery applications comes this valuable set of Battery Engineering Bulletins — a total of 34 fact-filled pages . . . YOURS for the asking.

● The complete line of "Eveready" batteries includes types and sizes for every kind of dry-battery-operated device. Design *your* equipment around a *standard* "Eveready" battery and gain the advantages of lower-cost operation, ready availability to the user and superior performance with *exactly* the right battery for the job.

The terms "Eveready" and "Mini-Max" are registered trade-marks of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.
District Sales Offices: Atlanta, Chicago, Dallas, Kansas City, New York, Pittsburgh, San Francisco
IN CANADA: National Carbon Limited
Montreal, Toronto, Winnipeg

Your Helping Hand...

HUDSON RADIO & TELEVISION CORP.

DOWNTOWN
UPTOWN

One Call for All!

EVERYTHING IN ELECTRONIC EQUIPMENT FOR LABORATORY AND INDUSTRY

If it's NEW . . . HUDSON has it FIRST! Leading Authorized Distributor of Electronic Equipment in the East . . . Your ONE Complete Dependable Source.

HEADQUARTERS FOR RCA

RCA AUTHORIZED DISTRIBUTOR

RCA TUBES • RCA PARTS RCA TEST EQUIPMENT

Always in Stock for Prompt Delivery

FREE! New 1953 HUDSON CATALOG...

. . . your helping hand for Everything in Electronic Equipment. Over 196 pages of the latest in Radio, TV and Industrial Electronics. High Fidelity and PA Sound Equipment PLUS JAN type Electronic Components with latest JAN Cross-Reference Guide. Send for your copy . . . KEEP IT HANDY for ordering . . . It's Quick, Convenient . . . Time and Money Saving! ONE Order, ONE Dependable Source— ONE Call for ALL!

Send for FREE Catalog to Dept. T-3

You're Invited...

When you attend the IRE SHOW, you're invited to visit our uptown salesroom, adjoining Radio City . . . only 4½ blocks from Grand Central Palace! Make yourself at home. See our Vast Facilities . . . Tremendous Stocks . . . Gigantic Salesrooms! . . . Meet the men who serve America's foremost users of electronic equipment. Open until 9 P.M. during show time, March 23-26.

HUDSON RADIO & TELEVISION CORP.

48 WEST 48th ST. • 212 FULTON ST.
New York 36, N. Y. New York 7, N. Y.
Circle 6-4060

What to see at the Radio Engineering Show

(Continued from page 152A)

Electro Precision Products, Inc., College Point, L.I., N.Y. 3-410
RF Components: Connectors, Microwave Equipment and Waveguide Assemblies.

Electro Tec Corp.
South Hackensack, N.J.
4-215

Manufacturers of Precision Slip Ring Assemblies and Commutators. Electro Tec assemblies are specified by the nation's leading precision instrument and equipment manufacturers for proven greater dependability and longer life. Our process, employing one-piece construction, precludes dimensional variations due to accumulated errors. Our Engineering Department is available for consultation without obligation.

Electronic Associates, Inc.
Long Branch, N.J.
1-114-115

Analog Computers, Plotting Boards, and Data Reduction Equipment.

Electronic Computer Division of Underwood Corp., New York 13, N.Y. 4-425, 427
An electronic digital computer in operation may be seen at this exhibit. It is the Elecom 100, first moderately priced computer to be offered commercially. You can see this machine doing mathematical computations, and also performing payroll calculations. If you give it your earnings and deductions, it will even figure your income tax.

Electronic Devices, Inc., Brooklyn 15, N.Y. 4-219
Selenium Rectifiers for every purpose—manufactured by a unique process which produces Rectifier plates of extremely high reverse resistance and extremely low forward resistance. Minisel—High Voltage—Low Current Rectifiers. Plastisel—Enclosed subminiature Rectifiers. Recti-sel—Conventional open type Rectifiers. Hermetically sealed Selenium Rectifiers. And a preview of a new type of Rectifier, the Ventisel.

Electronic Instrument Co., Inc., Broklyn 11, N.Y. 4-401
Electronic Test Instruments. Pre-wired or kits.

Electronic Mechanics, Inc.
Clifton, N.J.

4-610

Mykroy Teflon Kel-F

EPM TUBE PARTS

Electronic Parts Mfg. Co., Inc.
Union City, N.J.
Booth 3-508

Components for the ELECTRONIC FIELD

LEADS • SPRINGS • COILS
MACHINED TUBE PARTS • BEADING
CONTACTS • FORMED PARTS

(Continued on page 156A)

see these NEW COLLINS Advancements

at the IRE Show, March 23 to 26
Grand Central Palace, New York City

NC-101 Navigation System. Punch-card operated navigation equipment which automatically computes air miles to-from a selected destination.

618S Transceiver, 180L-2 Antenna Tuning Unit. A Transmitter-Receiver with 144 channels, automatically tuned — 2 to 25 megacycles — full 100 watt power.

51Z Marker Beacon Receiver. Fixed tuned to 75 megacycles — uses 8 ARINC tubes — Collins designed 3 light indicator. undesirable R-f signals rejected.

75A-3 Amateur Receiver. Incorporates 2 Mechanical I-F Filters with controls in addition to proven features of 75A-2 for instantaneous choice of desired selectivity.

17M VHF Transmitter. 360 channels — full 50 watt signal for executive and air-line use. Operates between 118.0 and 135.9 mc. with fingertip remote control.

Integrated Flight System. Provides the pilot with pictorial presentation of all necessary information for precise ILS approach flying and VOR navigation.

These and many other COLLINS developments will be on display.

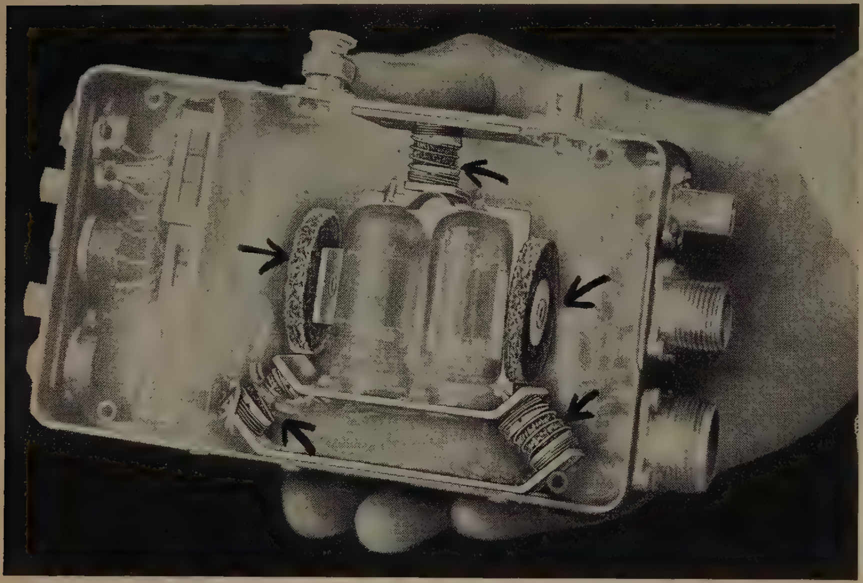
For advanced electronic communications and navigation equipment, it's . . . COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 W. 42nd St., NEW YORK 36
1930 Hi-Line Drive, DALLAS 2
2700 W. Olive Ave., BURBANK

...solved another **VIBRATION** *problem*

Sensational advances and increasing use of electronics and precision instruments have raised problems of vibration and shock unheard of a few years ago. How Robinson is meeting these problems is illustrated in this new Simmonds electronic aircraft fuel gage amplifier.



A Robinson internal mount, protecting only the critical component parts, fully isolates vibration and shock. Not only is service life greatly extended, but at the same time important savings in size and weight are achieved. The entire amplifier unit is so small it fits in the palm of your hand and weighs only 1 lb. 3 oz.

Wide range of applications

Robinson Met-L-Flex mounts are so versatile in application that they may be designed to protect light precision instruments, electronic equipment of any size or weight, or heavy equipment.

For more information about this new kind of engineered vibration control, drop us a line.

Visit Us at the I.R.E. Convention Booth Nos. 2-216 and 2-217

ROBINSON AVIATION INC.
TETERBORO, NEW JERSEY
Vibration Control Engineers

What to see at the Radio Engineering Show

(Continued from page 154A)

Electronic Tube Corp., Philadelphia 18, Pa. 2-519
Special purpose cathode-ray tubes and multi-channel oscilloscopes.

NOISE & FIELD INTENSITY METERS
DISTORTION ANALYZERS
IMPULSE GENERATORS
COAXIAL ATTENUATORS
CRYSTAL MIXERS
VISIT OUR BOOTH NO. 2-147

EMPIRE DEVICES, INC.
38-25 BELL BLVD.
BAYSIDE 61, N.Y.

Engineering Research Associates, Inc.
St. Paul 4, Minn.
4-913 & 915

Exhibits include an ERA 1103 General-Purpose Computer (model and Photos); ERA 1101 General-Purpose Computer (photos); ERA Magnetic Storage Drum, also slide sequence; ERA Shaft-Monitor Analog-to-Digital Converter; Automatic Conveyor Line Sorting System with ERA Industrial Memory and Dynamic Weigher; ERA Magnetic Recording Delay Line; Pulse Transformers; Plug-In High-Gain Amplifier.

Equipto Div. Aurora Equipment Co., Aurora, Ill. 4-805
Electronic Equipment designed for your needs. Storage for incoming and outgoing work—warm up or heat run racks—Electronic chassis and test equipment stand. Steel shelving and drawer units for the small fragile parts as well as the large bulky items.

Erie Resistor Corp.
Erie, Pa.

Booth 1-123

A Complete Line of
High Quality
Electronic Components

Erie Resistor Corp., Erie, Pa. 1-123
Fixed and variable ceramic capacitors, Button Silver Mica Capacitors, Deposited Carbon Resistors, Piezo Electric Active Barium Titanate Discs, Suppressors, Electronic Subassemblies, and Printed Circuits.

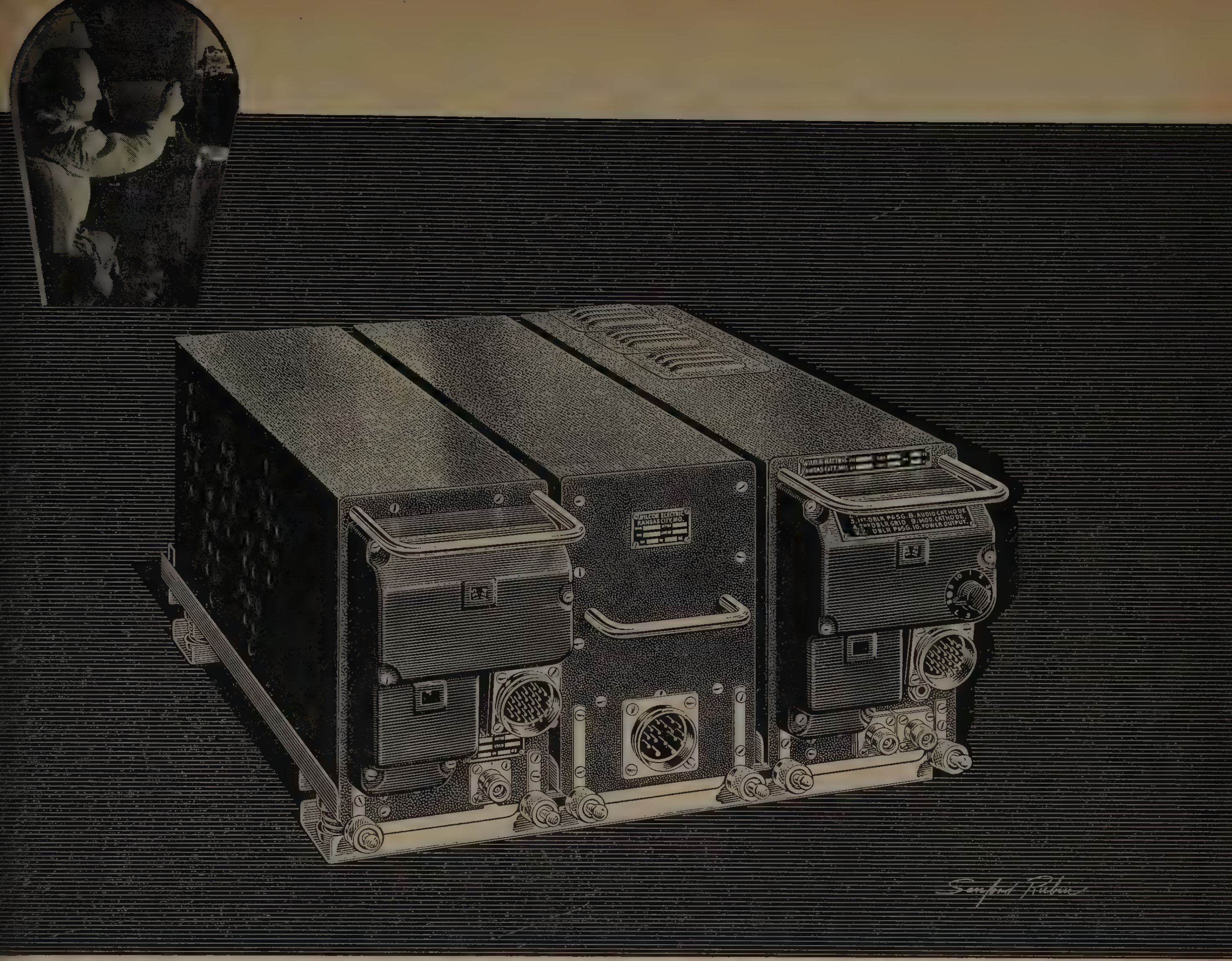
Etched Products Corp.
Long Island City 1, N.Y.

4-617

Etched Circuits. Modern practice in etched circuitry.

Fairchild Camera & Instrument Corp., Hicksville, L.I., N.Y. 2-405
Linear and nonlinear precision potentiometers, types 736, 746, 747 and 748, single, ganged and plug-in models.

(Continued on page 162A)



You didn't hesitate a minute!

Long ago you learned a concept of buying this world's goods that has stood you well. You learned how wise it is to examine the grain of fine leathers. You learned that more than dedicated craftsmanship is woven into the warp and woof of fine woolens. You learned that, year-in-year-out, quality *more* than pays its way.

Your concept of buying was confirmed by happy and painful experiences in purchasing materials and services in the business world. This concept became a part of you . . . part and parcel of your hard-won maturity of judgment.

You faced a communications equipment decision for your corporation's aircraft. You heard that the Wilcox 440A VHF Airborne System—used by airlines all over the world—had been designed and built to unparalled standards of quality. That not once—from dream to drawing board to loading dock—had the promise of *dependability* been compromised.

Each feature offered stronger evidence. Powerful plane-to-tower attention guaranteed by the 50 watt transmitter. Clear-as-a-bell signals *always* because of the extra sensitive receiver. You grew more excited as you learned that no matter where in the world you fly—now or in the future—*all 180 channels* would be yours to use.

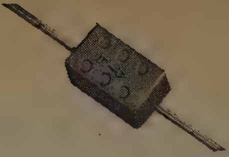
Then it came—the icy realization that you couldn't take a chance, that far more than an equipment purchase was at stake.

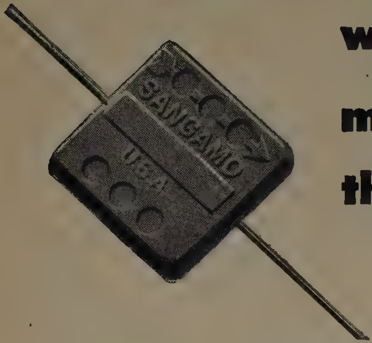
And you didn't hesitate a minute!

Your inquiry on the Wilcox 440A System or its companion, the Wilcox 429A Glideslope Receiver, is invited. Please address your inquiry to the personal attention of Mr. Donald E. Busse.

wilcox
Electric Company, Inc.
1406 Chestnut
Kansas City 27, Missouri, U.S.A.

NOW..Wire Lead Micas with 500 times better moisture resistance than ever before!





Sangamo HUMIDITITE* Mica Capacitors

When you use Sangamo HUMIDITITE molded Mica Capacitors, you gain all the advantages of an amazing moisture seal that offers previously unheard-of moisture resistance characteristics for compression molded plastic-encased mica capacitor components.

***what is HUMIDITITE?**

Humiditite is a remarkable new plastic molding compound, developed by Sangamo, that gives Sangamo Mica Capacitors moisture resistance properties far superior to any others on the market.

HERE'S THE PROOF . . . The standard moisture resistance test described in MIL-C-5A (proposed) Specification requires mica capacitors to offer at least 100 megohms of insulation resistance after ten 24 hour cycles in a humidity chamber at 90% to 95% relative humidity. The best competitive micas barely meet this requirement . . . but Sangamo HUMIDITITE Micas, *under the same conditions*, all tested in excess of 50,000 megohms! Continued tests, over and above requirements, with the same HUMIDITITE Micas, proved them capable of withstanding from 21 to 52 cycles (from the smallest sizes to the largest) before failure.

Humiditite is just another example of the advanced engineering that enables Sangamo to meet the existing and future needs of the electronic industry. For additional information about HUMIDITITE, write for Engineering Bulletin No. TS-111.

Those who know... choose Sangamo

The Little Indian

SANGAMO
ELECTRIC COMPANY
MARION, ILLINOIS

SC53-5

See Us in Booth 3-510 Radio Engineering Show, March 23-26

What to see at the Radio Engineering Show

(Continued from page 156A)

Fairchild Camera & Instrument Co.
Jamaica 1, L.I., N.Y.
2-405 & 406

Precision linear & non-linear potentiometers.

Fairchild Recording Equipment Corp., Whitestone, L.I., N.Y. 3-400
Professional synchronous tape recorders, disk recorders and transcription tables, multi purpose pickups, equalizers, preamplifiers, cuing amplifiers, thermostylus kits, control track generators, automatic framing devices, etc.

Falstrom Co.
Passaic, N.J.
4-507

Instrument Panels; Aluminum and Steel Fabrication; Consoles and Cabinets; Enclosures and Housings; Television and Radio Control Cabinets; Transmitter Cabinets; Transmitter Cabinets; Long and Short production runs; Custom metal assemblies.

Federal Telecommunication Labs., Inc., Nutley 10, N.J. Federal Hall 1-707
Typical UHF Television Station, Exhibit of Microstrip-Microwave Printed Circuitry, Exhibition of High Quality Materials and Components.

Federal Telephone & Radio Corp., Clifton, N.J. Federal Hall 1-107
Communication equipment.

Federal Tool Engineering Co.
Cedar Grove, N.J.
4-505

Small parts welding demonstration, automatic tab welding. Machines, examples of Microscopic welding. Technical and practical answers to your welding problems.

Federated Metals Div., American Smelting & Refining Co., New York 5, N.Y. 4-511 & 513
Federated exhibit booth will include periodic demonstrations of their new "RTS-200" Rosin Core Solder. Proven by actual tests to be (5) five ways better than ordinary rosin solders, the properties and working characteristics of "RTS 200" will be demonstrated for all to see.

Federated Semi-Conductor Co.
New York, N.Y.
4-605

Exclusive Sales Agents for Germanium Products Corp., Jersey City, N.J. Manufacturers of N-P-N Junction Transistors and Semi-Conductor Devices, Booth 4-605, on Components Ave., near elevators.

Federated Semi-Conductor Co., New York 7, N.Y. 4-605
N-P-N Junction Transistors and Semi-Conductor devices. Sole agents for Germanium Products Corp.

(Continued on page 164A)

LEADING MANUFACTURERS find it GOOD BUSINESS to specify *Heldor*

LEONARD ELECTRIC PRODUCTS

SYLVANIA

how about YOU?

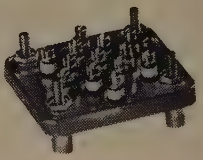
- SAVE TIME
- SAVE MONEY
- SAVE INVENTORY LOSSES
- SAVE PRODUCTION HEADACHES
- INCREASE PRODUCTION CAPACITY

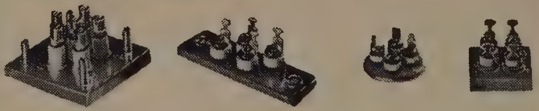
Take advantage of Heldor's complete assembly service — its compression-type hermetic seal bushings ASSEMBLED in can covers to meet MIL-T-27 or commercial specifications — ready for your final assembly. Send specifications or prints on your can, bushing or assembly requirements. *You'll save plenty!*

Just off the Press! Write today for your copy of the new Heldor "Cans and Covers" catalog.

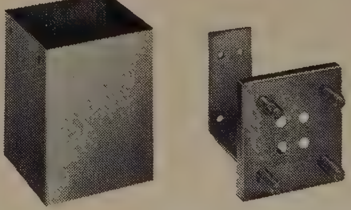
— *Heldor* —

COMPLETE ASSEMBLY SERVICE

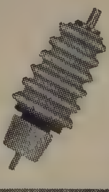




CANS



HERMETIC SEAL BUSHINGS



Heldor

HELDOR MANUFACTURING CORPORATION

HELDOR BUSHING & TERMINAL CO., INC.

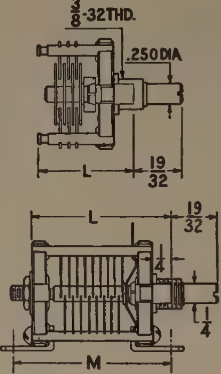
225 Belleville Ave., Bloomfield, N. J.

SEE HELDOR AT BOOTH 2-111, 1953 IRE SHOW, GRAND CENTRAL PALACE

JOHNSON Type L Capacitors

High frequency capacitors designed to absorb punishment. Full soldered construction makes JOHNSON "L" variables virtually impervious to the effects of shock and vibration. No parts can work loose — capacity can't fluctuate. Ideally suited for airborne and mobile transmitting, receiving applications.

Plates are heavy .020" brass with corrosion resistant bright alloy plating. *Rotor and stator assemblies are soldered; split sleeve bearing, mounting posts, tie rods and stator assembly are all soldered directly to the heavy ceramic end plates.* Steatite insulators are located outside the most intense RF fields for lowest possible losses at very high frequencies. Silver plated beryllium copper rotor contact may be brought out at any one of four different angles. This, together with dual stator contacts, insures short, low inductance leads in any application.



	Cat. No.	Type No.	Cap. per Sect. Max.	Cap. per Sect. Min.	*Spacing	Plates Per Sec.	L
a SINGLE SECTION	Single End Plate						
	167-101	10L15	11	2.8	.030"	3	15/16
	167-102	25L15	27	3.5	.030"	7	1 3/64
	167-103	50L15	51	4.6	.030"	13	1 7/16
	167-104	75L15	75	5.7	.030"	19	1 3/4
	Double End Plate						
	167-151	100L15	99	6.8	.030"	25	2 7/32
	167-152	200L15	202	11.6	.030"	51	3 33/64
b DUAL SECTION	167-501	25LD15	27	3.5	.030"	7	1 13/16
	167-502	50LD15	51	4.6	.030"	13	2 27/64
	167-503	100LD15	99	6.8	.030"	25	3 5/8
c DIFFERENTIAL	167-301	10LA15	11	2.8	.030"	3	15/16
	167-302	25LA15	27	3.5	.030"	7	1 3/64
	167-303	50LA15	51	4.6	.030"	13	1 7/16
d BUTTERFLY	167-201	10LB15	10.5	2.8	.030"	5	1 3/64
	167-202	25LB15	26	4.3	.030"	12	1 7/16
	167-203	50LB15	51	6.8	.030"	23	1 15/16

*.020, .060, .080 spacing also available.

We have produced numerous special "L" capacitors including those with .020", .060" and .080" plate spacing. Other specials have incorporated such features as, slotted end rotor plates, bearings for motor driven applications, integral inductors, special shafts, etc.

Adapting JOHNSON capacitors to difficult applications is part of our business. We'll be more than glad to help. Like to know more about JOHNSON capacitors? Send for catalog 973.

E. F. JOHNSON CO. WASECA, MINNESOTA

E. F. JOHNSON COMPANY

CAPACITORS, INDUCTORS, SOCKETS, INSULATORS, PLUGS, JACKS, DIALS, AND PILOT LIGHTS

204 SECOND AVENUE SOUTHWEST • WASECA, MINNESOTA

What to see at the Radio Engineering Show

(Continued from page 162A)

Ferris Instrument Co., Boonton, N.J. 1-301, 302 & 303
Radio Receiver Testing Equipment—Signal Generators, Radio Noise and Field Strength Meters, Calibrators, Slotted Measuring Lines.

The Filtron Co., Inc.
Flushing, L.I., N.Y.
1-502

Radio Frequency Noise Suppression Filters.

T. R. Finn & Company, Inc.
New York 54, New York
4-611

Vibration and shock control equipment—Aluminum mounting bases for airborne electronic equipment—Fire control shock mounts—Signal Corps shock mounts, etc.

Fisher Radio Corp., New York 17, N.Y. Theatre 3-304A
Model 50A Laboratory Standard Amplifier, Model 50C Master Audio Control, Model 50R Tuner, Model PR-4 Pre-Amplifier and other audio accessories. This display will be in conjunction with the new 1501 Concertone and Network Recorders.

Ford Instrument Co.
Div., The Sperry Corp.
Long Island City 1, N.Y.
2-315

FORD

Servo control motors, Synchros, Linear potentiometers, Differentials, Integrators, Resolver systems, Three dimensional cams, Magnetic amplifiers and similar items.

Ford Instrument Co., Div., The Sperry Corp. Long Island City 1, N.Y. 2-315
Precision built components and sub-assemblies developed for armament controls and computers. Made to highest government specifications for use in aircrafts, warships and other military equipment. Including servo control motors, synchros, linear potentiometers, differentials, integrators, resolver systems, three dimensional cams, magnetic amplifiers and similar items.

Freed Transformer Co., Inc.
Brooklyn 27, N.Y.
1-109

Power and Cummunication Components for Commercial and Military Applications: Power, Audio, Pulse and Supersonic Frequency. Transformers: Reactors, Filters, Discriminators and High "Q" Toroid Inductors. Precision Measuring Equipment: Vacuum Tube Voltmeters, Megohmmeters, Bridges, Decade Inductors, Condenser Decades, Low Frequency "Q" Meter, Null Detectors, Comparison Bridges, Frekuency Standards and Harmonic Distortion Meters.

(Continued on page 166A)

AIDS FOR THE ELECTRONIC ENGINEER-DESIGNER

Visit our exhibit at
BOOTHS 2-103, 104
Second Floor
I.R.E. SHOW

CAN YOU USE THESE UNUSUAL QUALITIES IN YOUR PRECISION EQUIPMENT?

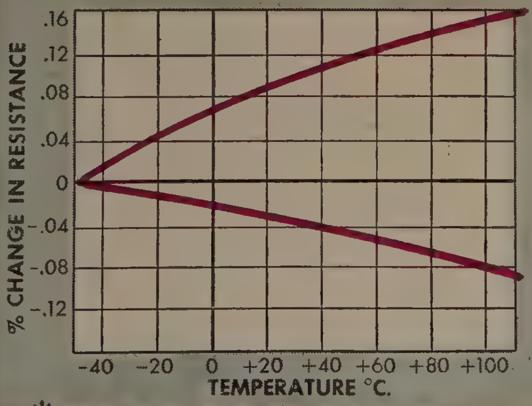
Specify EVANOHM*

RESISTANCE WIRE

for high specific resistance...low temperature coefficient and low thermal EMF to copper... great stability over wide temperature ranges

EVANOHM is recommended for all precision applications where complete dependability for a wide temperature range is essential. It is especially well suited for guided missiles, rockets and other airborne equipment.

EVANOHM* RESISTANCE CURVE, CHARACTERISTICS AND PROPERTIES



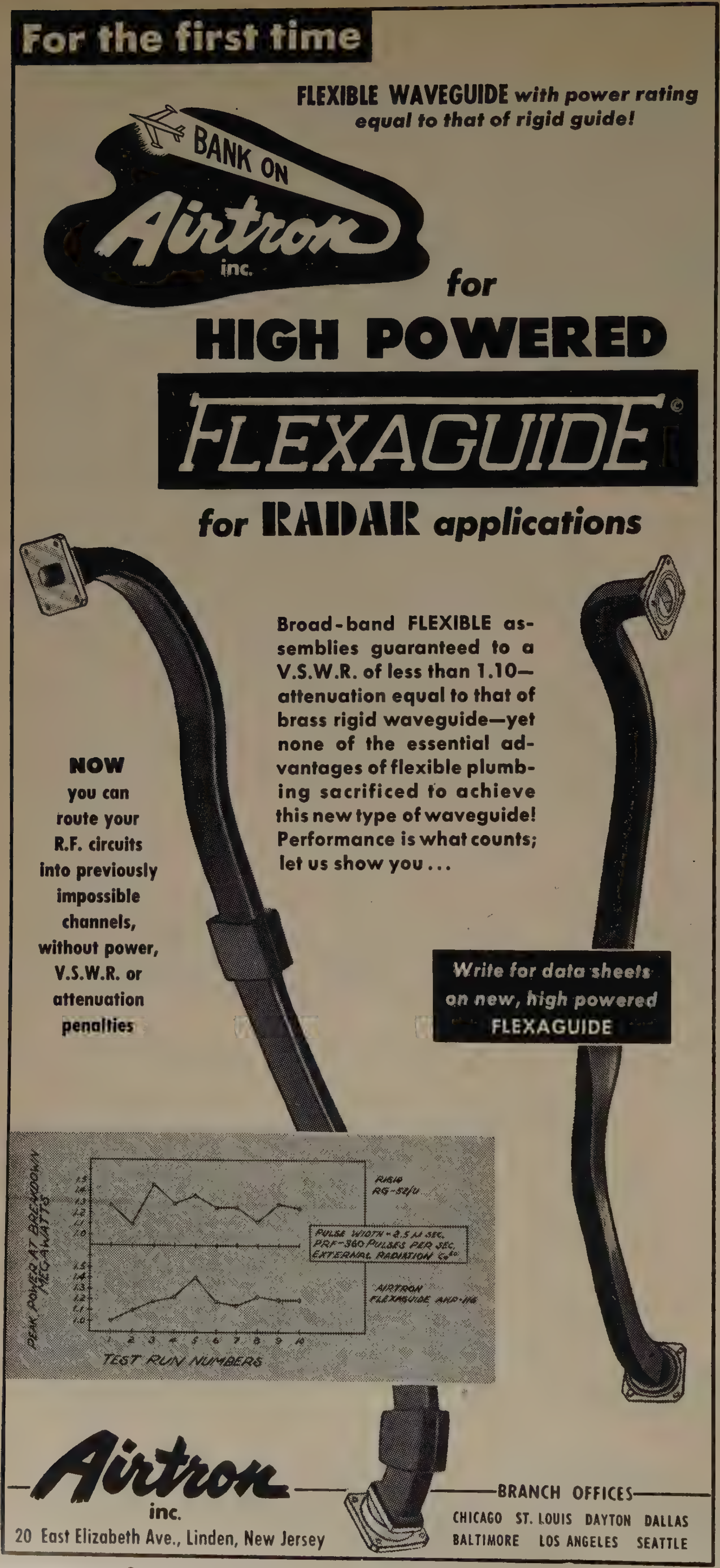
1. Analysis — Ni 74.75%, Cr 20.00%, Al 2.75%, Cu 2.50% **2.** Excellent corrosion resistance. **3.** Resistivity — 800 ohms per circular mil foot (134 microhm cm.) **4.** Temperature coefficient of electrical resistance — Plus or minus .00002 ohms per ohm per degree centigrade between minus 50°C. and plus 105°C. **5.** Thermal E.M.F. vs. Copper — .0025 mv. per degree between —50 and 105°C. (max.) **6.** Non-magnetic. **7.** High tensile strength in fine sizes — 150,000 to 200,000 p.s.i. **8.** It may be readily welded or brazed and soft soldered with special care. **9.** Available in: (a) Bare wire sizes .0009 and larger. (b) Enameled, Formex, Cotton, Silk, Nylon and glass insulated wire in sizes .0015 to .0113.

*EVANOHM — *a patented, exclusive alloy produced by*

* REGISTERED TRADE NAME

TOPHET FOR TOP HEAT

WILBUR B. DRIVER CO.
RIVERSIDE AVENUE, NEWARK 4, NEW JERSEY



For the first time

FLEXIBLE WAVEGUIDE *with power rating equal to that of rigid guide!*

BANK ON Airtron inc. for

HIGH POWERED

FLEXAGUIDE©

for RADAR applications

Broad-band FLEXIBLE assemblies guaranteed to a V.S.W.R. of less than 1.10—attenuation equal to that of brass rigid waveguide—yet none of the essential advantages of flexible plumbing sacrificed to achieve this new type of waveguide! Performance is what counts; let us show you . . .

NOW you can route your R.F. circuits into previously impossible channels, without power, V.S.W.R. or attenuation penalties

Write for data sheets on new, high powered FLEXAGUIDE

Airtron inc.
20 East Elizabeth Ave., Linden, New Jersey

BRANCH OFFICES
CHICAGO ST. LOUIS DAYTON DALLAS
BALTIMORE LOS ANGELES SEATTLE

See us at Booth 3-102 Radio Engineering Show

What to see at the Radio Engineering Show

(Continued from page 164A)

Furst Electronics, Chicago 25, Ill. 3-104
Klystron Power supplies, wideband D.C. amplifiers, wow meter, & laboratory power supplies.

The Fusite Corp., Cincinnati 13, Ohio. 3-109
A complete line of Fusite glass-to-metal terminals for hermetic sealing of all types of electrical components. Exhibit will include Fusite terminals applied to actual products of our customers in the field of electronics, instruments, switches, transformers, and refrigerator compressors.

Gates Radio Co., Quincy, Ill. 2-324, 325 & 326
New Equipment for TV: Broadcast and Communications Including the new Gates VHF 500 watt Television Transmitter. New Audio Control Apparatus, featuring a new Speech Input Control Console. A low Frequency Communication Transmitter, of recent design. Several assemblies and group displays for TV, Broadcast and Communications.

General Ceramics & Steatite Corp.
Keasbey, N.J.

1-506

Ceramics, Ferramics and solder seal bushings.

General Electric Co., Chemical Dept., Pittsfield, Mass. 1-201 & 207
G-E Textolite* Industrial Laminates—New Punching grades, fire resistant laminates, punched parts and assemblies for the radio and electronics industry. New G-E Mico Mat insulation for electronic applications.

General Electric Co. Apparatus Sales Div., Schenectady 5, N.Y. 4-120
In the Radiation Annex see: High Temperature Type and Air Equivalent Type Ionization Chambers and Radiation Monitors; Neutron Counter Tube Proportional Counter; Pocket Chamber Electro-meter Readers; Alpha, Beta, Gamma, and Thermal Neutron type Scintillation Counters, and Portable Radiation Probe.

General Electric Co.
Apparatus & Sales Divs.
Schenectady 5, N.Y.
1-201 & 207

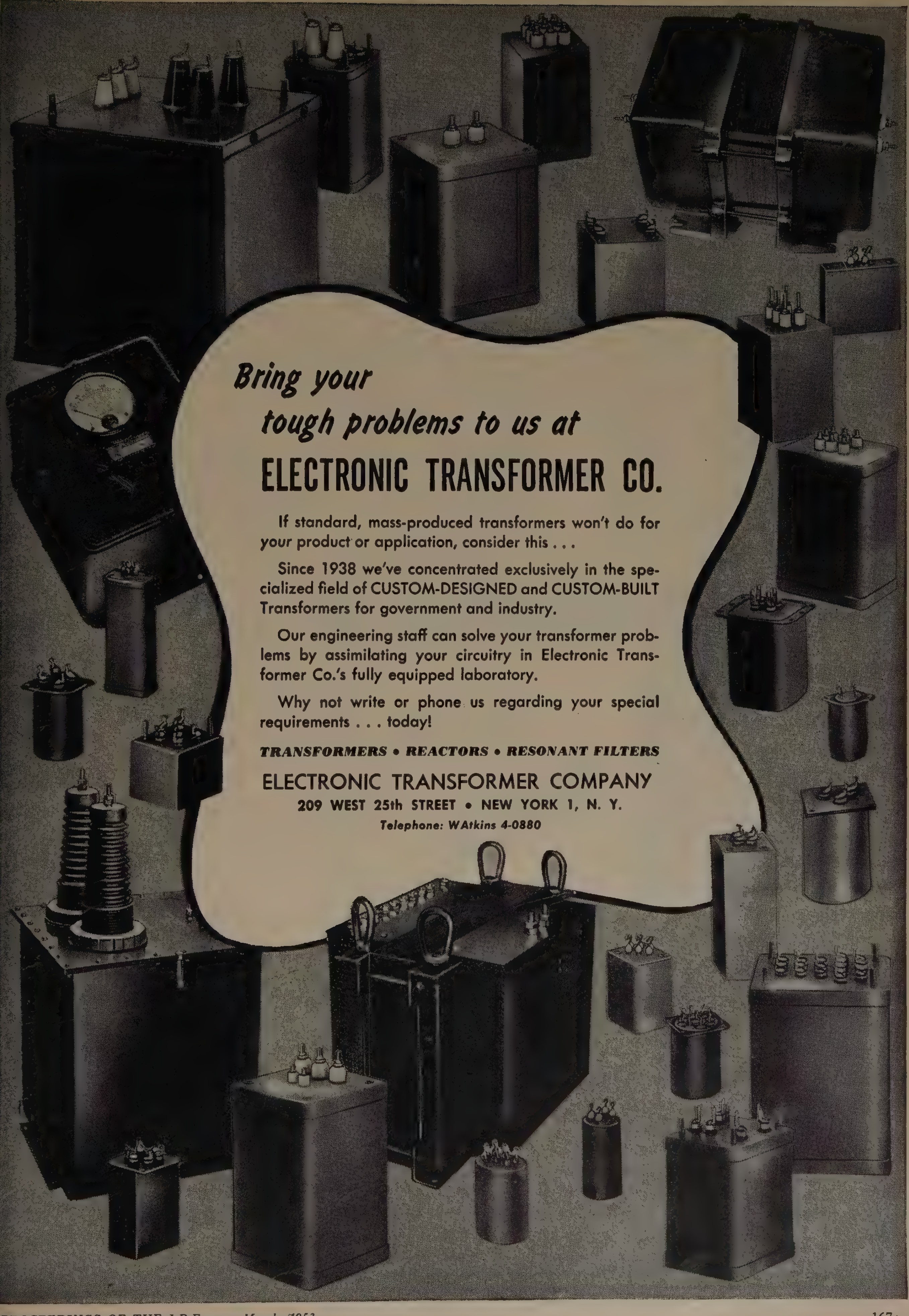
Permafil, Tantalytic, Drawn Oval, and Sub-Miniature Capacitors, and Capacitor Pulse Forming Networks; Selenium Rectifiers; High Voltage Components; Reactors and Pulse Transformers; Amplistats and Specialty Transformers; Thyrite Resistance Material; Soldering Irons; Relays for Airborne Electronic Equipment; Inductrols for Variable Voltage Control; and Electronic Signal Delay Lines.

General Electric Company
Electronics Dept.
Syracuse, N.Y.
1-201 & 207

Complete line of transmitting and receiving tubes for UHF television; 15 KW Klystron; 21″, 24″, and 27″ aluminized picture tubes; five star reliable tubes; Germanium products emphasizing the use of Germanium transistors and unction rectifiers; Oscilloscopes, signal generators; Regulated power supply; Germanium diode checker and new frequency and modulation meter.

General Instrument Corp., Elizabeth 3, N.J. 4-518
TV V.H.F. Tuners, TV U.H.F. Tuners, Variable Air Capacitors, Complete R.F. Tuning Units, Complete Electronics Assemblies, UHF Converters. F. W. Sickles Division: 90° Deflection System, 70° Uniform Deflection Systems, I.F. Coil Assemblies, Miscellaneous Small Coils, S-Trans.

(Continued on page 168A)



Bring your tough problems to us at

ELECTRONIC TRANSFORMER CO.

If standard, mass-produced transformers won't do for your product or application, consider this . . .

Since 1938 we've concentrated exclusively in the specialized field of CUSTOM-DESIGNED and CUSTOM-BUILT Transformers for government and industry.

Our engineering staff can solve your transformer problems by assimilating your circuitry in Electronic Transformer Co.'s fully equipped laboratory.

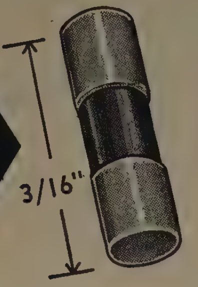
Why not write or phone us regarding your special requirements . . . today!

TRANSFORMERS • REACTORS • RESONANT FILTERS

ELECTRONIC TRANSFORMER COMPANY
209 WEST 25th STREET • NEW YORK 1, N. Y.
Telephone: WAtkins 4-0880

MICROWAVE RESISTORS
TELEWAVE TYPE R

SMALLEST RESISTOR AVAILABLE
(Ideal for Miniaturization)



TYPICAL APPLICATIONS
- Power measurement at any frequency
- Matched terminations for waveguides or coaxial lines
- Resistive power pickup loops
- RF pads or attenuators
- Dummy loads
- Temperature measurements
- Impedance matching

TYPE R RESISTORS employ noble metal film deposits on specially selected heat resistant glass.

FILM THICKNESS offers negligible skin effect, at microwave frequencies.

POWER CAPACITY of 1/4 watt provides high power handling ability.

PHYSICAL STRUCTURE is ideally suited to impedance matching in standard coaxial line and waveguides.

FINISH. Coated with a special silicone varnish to protect the film.

SPECIFICATIONS
Resistance: 50 ohms standard, other values on request.
Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 25°C
Size: 1/16 inch diam. x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 — 1/16 inch
Type R-093 — 3/32 inch
Temperature Coefficient: approx. 0.0019 ohms/ohm/°C.
Power Sensitivity: Approx. 10 ohms/watt

AVAILABLE FOR IMMEDIATE DELIVERY

TELEWAVE LABORATORIES, INC.
100 Metropolitan Ave. • Brooklyn 11, New York

A NEW SWITCHCRAFT "LITTEL-PLUG"

No. 480 "Littel-Plug" (JAN type PJ-068) features a unique assembly of metal parts, assembled into the mold as inserts; providing a finished plug with complete continuity of thermoplastic insulation. Design and material strictly in accordance with specification JAN-P-642.

See this *New* Switchcraft "LITTEL-PLUG" and Many Other New Products at Booth No. 3-114 IRE Show—March 23-26

Write for catalog

SWITCHCRAFT INC.
1332 N. Halsted St., Chicago 22, Ill.

Canadian Representative: Atlas Radio Corp. Ltd., 560 King St., W, Toronto 2B, Canada
Phone: Waverly 4761

* The name "Switchcraft" is a registered trade mark and is the property of Switchcraft, Inc.

AVAILABLE AT ALL LEADING RADIO PARTS JOBBERS •

What to see at the Radio Engineering Show

(Continued from page 166A)

General Precision Laboratory, Inc.
Pleasantville, N.Y.
1-407, 409 & 411

Studio Television Cameras and associated equipment; professional 16mm projectors.

General Radio Co.
Cambridge 39, Mass.
1-121 & 122

Limit Bridge for Production Testing. Unit Instruments. UHF Impedance Measuring Equipment. Coaxial Elements and Adaptors. Standard-Signal Generators. Electronic Test Equipment.

General Transformer Co., Homewood, Ill. 4-310
Electrical transformers—Military and commercial, and military battery charger.

Germanium Products Corp., Jersey City 4, N.J. 4-605
N-P-N Junction Transistors, semi conductor devices. See: Federated semi-conductor.

Gertsch Products, Inc., Los Angeles 25, Calif. 4-113
Precision Instruments. Frequency Meters. Sonic and Ultrasonic Filters, Precision AC Potentiometers. Generation and measurement of frequencies, 20-1000 MC., ± 0.001%. Passive Filters from 37.5 cps to 160 KC, attenuation rate of 80 db per ½ octave. Measurement of AC voltages from 50 cps to 3000 cps, accuracy ±0.005%. 3000 cps to 50 KC, accuracy ± 0.05%.

G. M. Giannini & Co., Inc., Pasadena 2, Calif. 4-706
Precision potentiometers, commutators, pressure, gyro, accelerometer instruments, and digital recording computer.

John Gombos Co., Inc.
Irvington 11, N.J.
2-516

Precision Electronic Assemblies; Cross Bar Contact Switches; Buttontype Capacity Filters; Dial Light Sockets; Connectors; High Frequency and Ultra-High Frequency Connectors; Jack Assemblies and Crystal Converters.

Grant Pulley & Hdwe. Co.
Flushing, L.I., N.Y.
4-306

Electronic Equipment Slides, Radio and TV Chassis Slides, Special sliding devices.

Gray Research & Development Co., Manchester, Conn. 1-402 & 404
New TeloJector, Dual 2" x 2" slide projector for TV stations. Gray telops and associated studio equipment viscous damped transcription arms. Sound effect consoles. Special effects equipment for video. Gray audograph electronic soundwriters.

(Continued on page 172A)

POSITION WANTED

with a coil that has an important job to do, by a core made of G A & F Carbonyl Iron Powders. Core offers know-how born of long experience, high permeability, high Q, unusual stability and references from many major employers....

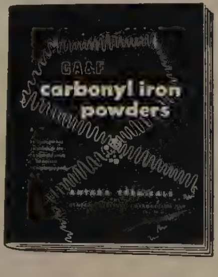
G A & F Carbonyl Iron Powders are used to produce cores for transformer and inductor coils of every form—to increase Q values, to vary coil inductances, to reduce the size of coils, to confine stray fields and to increase transformer coupling factors.

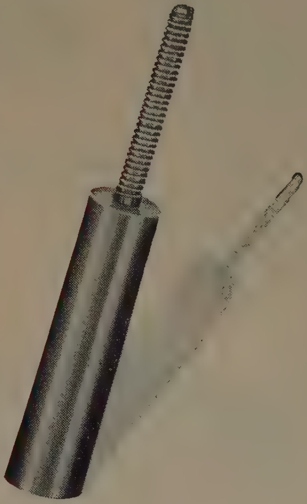
These powders are microscopic, almost perfect spheres of extremely pure iron. They are produced in seven carefully controlled types, ranging in average particle-size from three to twenty microns in diameter.

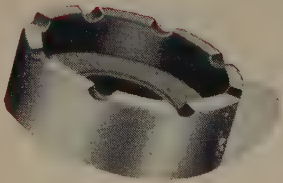
Similarly, their properties vary, making them useful in many different applications. Engineers have commented on the fact that cores made from these powders lend themselves to smoothness of adjustment and to ease of grinding. The extremely small size of the particles is of enormous value, since eddy currents develop only within each particle—proportional to the square of the particle diameter.

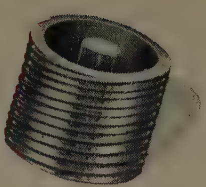
We urge you to ask your core maker, your coil winder, your industrial designer, how G A & F Carbonyl Iron Powders can increase the efficiency and performance of the equipment or product you make, while reducing both the cost and the weight.

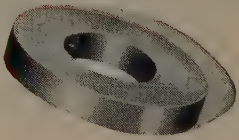
Write for wholly new 32 page book—the most comprehensive treatment yet given to the characteristics and applications of G A & F Carbonyl Iron Powders. 80% of the story is told with photomicrographs, diagrams, performance charts and tables. For your copy—without obligation—kindly address Department 40.

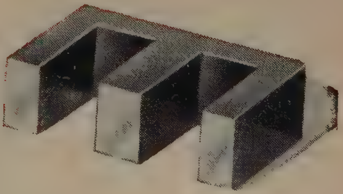












G A & F® CARBONYL IRON POWDERS

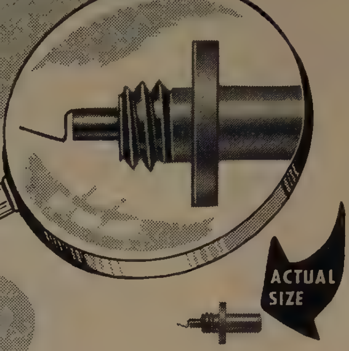
MEMBER
mpa
METAL POWDER ASSOCIATION

ANTARA® CHEMICALS

Division of **GENERAL DYESTUFF CORPORATION**
435 HUDSON STREET • NEW YORK 14, NEW YORK

gdc
ANTARA
gaf

What's Your Small Parts Welding Problem?



AN ALMOST MICROSCOPIC WELDMENT?

A MINIATURE COMPLEX WELDMENT?

WHATEVER YOU NEED, THERE'S A

TWEEZER-WELD

One of the many TWEEZER-WELD models—a fully Automatic Double Tabbing Machine for miniature tube cathodes.

that will fullfill your every welding requirement.

With Automatic Tweezer-Welders, you can weld better—faster—more economically—

better because Tweezer-Welders have the exclusive "automatic follow-through pressure" to assure uniform welding quality.

faster because all production operations are automatic.

more economically because there is no installation cost, no maintenance cost, low power consumption.

SEE TWEEZER-WELDERS IN ACTION
BOOTH #4-505 • RADIO ENGINEERING SHOW
MARCH 23, 24, 25, 26 • GRAND CENTRAL PALACE • NEW YORK CITY

SPECIALIZED CONTRACT WELDING SERVICES

—are being rendered at our plant to augment manufacturers' own welding departments or as a substitution for such departments. Your inquiry is invited.

Consultation with a TWEEZER-WELD engineer is recommended in adapting the equipment to an individual problem.

2305

TWEEZER-WELD

FEDERAL TOOL ENGINEERING CO.
1386 POMPTON AVENUE
CEDAR GROVE, N. J.

What to see at the Radio Engineering Show

(Continued from page 168A)

Grayhill, Ill. 4-612
See: Wally B. Swank.

Green Instrument Co., Inc., Cambridge, Mass. (39) 3-118
Pantograph engraver for name plates, dials and scales. Instrument panels up to 19" in height by any length. New GreenArc electric etching attachment. Rotary tables, drum dial fixtures, self-centering vises, clamping fixtures, and cutter grinder. Special machinery for production engraving.

Guardian Electric Manufacturing Co.
Chicago 12, Ill.
3-116 & 117

Hermetically sealed relays, miniature relays, solenoid contractors electrical components for industry and the Military.

Halldorson Transformer Co., Chicago 40, Ill. 4-615
Showing a complete stock-type transformer line or new construction and replacement in television, radio, amplifier, and other electronic applications. Line includes power, filament, audio, reactor, H.B. flyback and deflection yoke types. See also lines of isolation and autoformer types of Varivolt line-adjusting units.

Hammarlund Mfg. Co., Inc.
New York 1, N.Y.
4-214

DIVERSITY RECEIVERS

Now Available!—"Super Pro 600" receivers which incorporate facilities for operation in conventional dual diversity systems.

At the show for the first time will be displayed a complete new Hammarlund diversity system. It'll be in *Booth 4-214*. See it!

HAMMARLUND

Hammarlund Mfg. Co., Inc., New York 1, New York 4-214
New "HQ-140-X" Communications Receiver. Model of the "Super-Pro 600" Professional Communications Receiver. Data Transmission equipment for remote supervisory control and signaling applications. This will include the new "DSU-2" duplex signaling unit and the "RCR-RCT" remote equipment. Included among the line of variable capacitators on display will be the miniature units, the "MAPC" and the "MAC."

Hastings Instrument Co., Inc., Hampton, Virginia 4-420
Air-Meter, Vacuum Gauge, Electronic Standard Cell, Electronic Manometer and Flowmeter.

The A. W. Haydon Co., Waterbury (20), Conn. 1-619
Featured at the 1953 exhibit will be newly developed miniaturized Repeat Cycle Timers, Time Delay Relays and Elapsed Time Indicators designed expressly for military applications, primarily in the aircraft and missile field. These units are powered by the revolutionary A. W. Haydon standard or governed DC Motors or 400 Cycle AC Motor.

Heiland Research Corp.
Denver 9, Colo.
3-212

Oscillograph recorders, ranging from the smallest utilizing 35 MM film to the largest having a film width of 12 inches. Bridge Balance and strain indicator unit.

(Continued on page 178A)

All Band, Direct Reading

IMPROVED

SPECTRUM ANALYZER

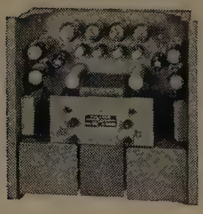
Model LSA

10 MC to 21,000 MC

The Model LSA is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an rf signal.

- Frequency accuracy 1 percent.
- No Klystron modes to set.
- Broadband attenuators supplied from 1 to 12 KMC.
- Frequency marker for measuring differences 0-25 MC.
- Only four tuning units required to cover entire range.

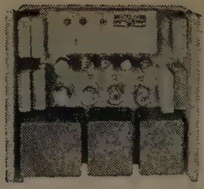
REGULATED POWER UNITS



MODEL PT111D

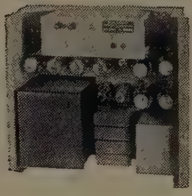
(Dual Regulated)

Consists of two independently regulated D.C. power sources (isolated from ground), mounted on one chassis. Each power source has its own power switch, fuse, pilot light and voltage control.



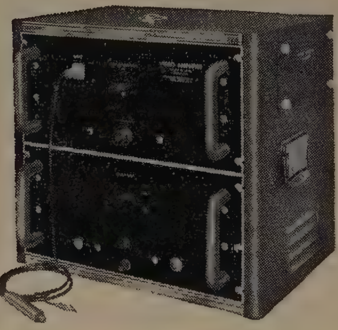
MODEL PT111

Consists of a positive and a negative voltage supply independently regulated.



MODEL PT112

Heavy duty electronically regulated D.C. power source.

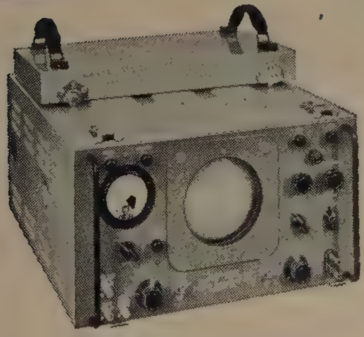


WIDE BAND VIDEO AMPLIFIER

Model VT 10 CPS to 20 MC

Designed for use as an oscilloscope deflection amplifier for the measurement and viewing of pulses of short duration and rise time.

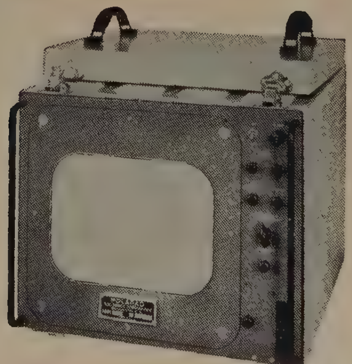
CORP. 100 METROPOLITAN AVENUE, BROOKLYN 11, N. Y.



PORTABLE TELEVISION WAVE FORM MONITOR

Model TO-1

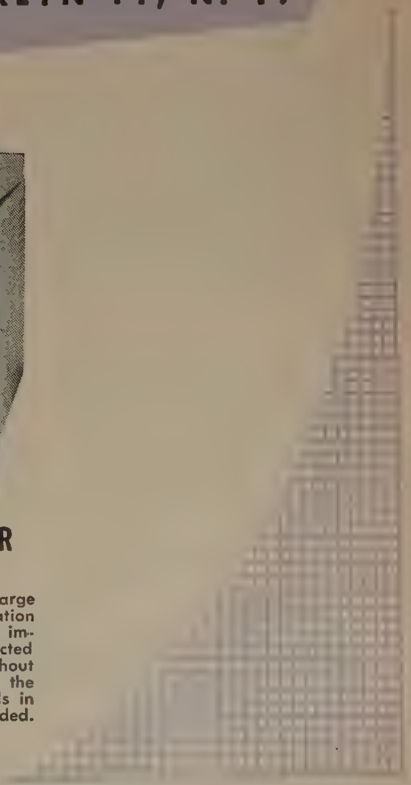
Designed for precise wave form analysis and amplitude measurement of video signal in television circuits. Also ideal as a general purpose instrument in many applications, because of its wide frequency response, high sensitivity, excellent synchronizing capability, precision calibrating circuits and unusually large symmetrical horizontal expansion.



STUDIO PICTURE MONITOR

Model M-105

A high fidelity picture monitor of large size, sufficient for ease of observation under studio conditions. It is a high impedance device and may be connected across a video transmission line without affecting the terminal impedance of the line. Monochrome and/or color signals in black and white reception is provided.



See us at Booth 2-511, Radio Engineering Show

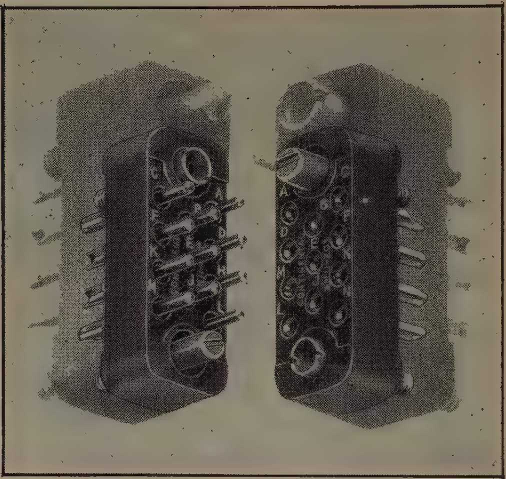
CONTINENTAL CONNECTOR news

MINIATURE, SUB-MINIATURE AND POWER PRECISION CONNECTORS

NEW SUB-MINIATURE 30% SMALLER

Without Sacrificing Pin Diameter

Here's the way to solve your sub-miniature connector problems without getting the usual complaints from Production because of special sub-standard wiring requirements, misalignment due to bent or broken contacts, and damaged moldings.



.040 DIAMETER CONTACT PINS

Although the unit itself is a full 30% smaller than our Series 20 miniature Connectors, the Continental Sub-Miniature Rectangular Series SM-20 Connectors feature the same husky .040 diameter contact pins — precision machined phosphor bronze and assembled in a unique floating arrangement to insure self-alignment of each individual contact for reduced engagement and disengagement force. POSITIVE POLARIZATION is achieved with the use of a reversed guide pin and guide socket.

NO SPECIAL WIRING NECESSARY

This new SM-20 Series, the only sub-miniaturized connector that will stand up under a *continuous 5 amp. operation,* requires no special wiring. Unlike other sub-miniatures, SM-20's use #20 AWG wire, thus avoiding the necessity for soldering sub-standard wires.

24 HOUR DELIVERY ON A VARIETY OF STOCK CONNECTORS

SM-20's presently can be supplied within 24 hours with either 11 or 20 contacts, and a choice of molding compounds . . . choice of mineral filled flame-resistant, high strength Melamine insulation, Plaskon glass reinforced alkyd type 440A, or Diallyl Phthalate type 1-501. All these stock SM-20 models have been designed to withstand the same adverse field conditions under which the popular miniature Continental Series 20 has been tested and approved by leading manufacturers.

CUSTOM MODELS AVAILABLE

Our engineering staff will be pleased to discuss your particular sub-miniature application problems. Sub-miniature connectors other than our stock designs delivered within 6 weeks. Please write for Bulletin S-M to DeJur Amsco Corporation, Dept. P-3, 45-01 No. Blvd., Long Island City 1, N. Y.

VISIT US AT BOOTH 4-125, I.R.E. SHOW

ELECTRONIC DeJUR U.S.A. INSTRUMENTS

Continental Connectors

DeJUR AMSCO CORPORATION

LONG ISLAND CITY 1, NEW YORK

What to see at the Radio Engineering Show

(Continued from page 172A)

Heinemann Electric Co.
Trenton, N.J.
4-620

Exhibit and demonstration of hydraulic-magnetic circuit breakers, time delay relays and overload relays for electronic circuits. A giant operating model will demonstrate circuit breaker response to various overload and short circuit conditions, and applicational data will be available showing the wide range of functions performed by circuit breakers in many practical new circuits.

Heldor Manufacturing Corp., Heldor Bushing & Terminal Co., Corp., Bloomfield, N.J. 2-111
Heldor compression-type Hermetic Seal Bushings, Transformer Cans and Covers to MIL-T-27 (plain, electro-tinned, electro-plated or painted) that can be supplied, punched, formed (with numerals) with weld studs; and the assemblies with terminals for hermetic seal transformers and other special applications. Also, Heldor drawn cans and covers; brackets; channels and end-bell.

Heldor BOOTH 2-111

THE *FIRST* NAME IN
- TRANSFORMER CANS & COVERS
- HERMETIC SEAL BUSHINGS
- ASSEMBLY SEALING SERVICE

HELDOR MANUFACTURING CORP.
Bloomfield, N.J.

The Helipot Corp.
S. Pasadena, Calif.
1-120

Precision linear wire-wound potentiometer-rheostats, helical (multi-turn) and single turn; turns counting indicating dials.

Heminway & Bartlett Mfg. Co., New York 36, N.Y. 3-513
NEW! Fungus-proof Nylon Lacing Cords and Flat Braided Tape. Their special synthetic resin coating resists growth of mold and micro-organisms—factors most often responsible for deterioration of linen and cotton lacing cords and tapes. High abrasion resistance—low moisture absorption—non-toxic to humans.

Heppner Mfg. Co.
Box 1207, Round Lake, Ill.
3-312

Loud speakers, horizontal transformers, ion traps, beam centering controls, focus devices, ferrite antenna coil correcting magnet, magnetic door catch.

Hermetic Seal Products Co., Newark, N.J. 1-701
Hermetic Seals: Glass-Metal, single or multiple headers for Relays, Condensers, Crystals, Transformers, etc., for all branches of the field of Electronics. The Only Seals you can hot tin dip at 525° F. for Easy Assembly Soldering, for a Strain and Fissure-Free Sealed Part with Resistance of over 10,000 Megohms!

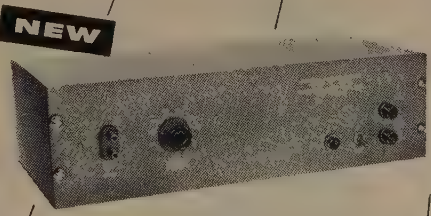
(Continued on page 180A)

the pioneer is the leader

PANORAMIC

As pioneers and developers of the panoramic technique, the measure of our success is reflected in the fact that the electronic field refers to the transformation of spectrum content into visual spectographic displays as the "Panoramic Method."

Panoramic leads the industry in producing instruments unexcelled for laboratory, research and production applications requiring high speed spectrum or waveform analysis. Whatever your problem, a Panoramic Analyzer solves it quickly, accurately. Specialized models covering audio to microwave frequencies simplify analysis of waveform distortions, sounds, vibrations, spurious oscillations or modulation, response characteristics of filters or transmission lines, characteristics of AM, FM or pulsed signals, or monitoring many frequency channels simultaneously.



ULTRASONIC RESPONSE INDICATOR—MODEL G-3

Used as an adjunct to the Model SB-7 Panoramic Ultrasonic Analyzer, the G-3 permits visual inspection of amplitude versus frequency characteristics of networks and devices between 2KC and 300KC. Direct readings of frequency and amplitude. Indicates fundamental response only.

SIGNAL SWITCHER—SW-1

Designed to apply alternately test and standard signals to Panoramic Sonic Analyzers. Enables frequency comparisons to within a fraction of a cycle. Used with the G-2 Sonic Response Indicator, it facilitates rapid comparisons of the frequency responses of amplifiers, filters, transmission lines, etc.

PANALYZOR—MODEL SB-12

Designed specifically for applications requiring extreme resolution or demanding measurement of levels of signals spaced very closely in frequency or widely divergent in amplitude.

- Maximum Sweepwidth—100KC
- Maximum Resolution—10 CPS
- Sweep Rates—30 cps, 5 cps, 1 cps and 1 scan in 10 seconds.

The new products described here, together with the complete line-up of standard Panoramic equipment will be demonstrated at the I.R.E. Show,

BOOTH #2-123

Models AP-1 & LP-1—Panoramic Sonic Analyzers, Model SB-7 Panoramic Ultrasonic Analyzer, Panalyzors—Models SB-3 & SB-8a, Panadaptors—Models SA-3 & SA-8a, Model G-2—Sonic Response Indicator.

THE MARK OF THE ORIGINAL PANORAMIC

PANORAMIC
RADIO PRODUCTS, INC.

Inquiries invited on special Panoramic Spectrum Analyzers

12 South Second Avenue, Mount Vernon, N.Y.
Mount Vernon 4-3970

WRITE TODAY FOR COMPLETE SPECIFICATIONS AND PRICES

Standard Piezo CRYSTALS

Rugged! Dependable! Accurate!

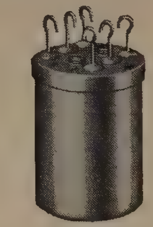
Send today for our new completely illustrated catalog of crystals or outline your particular crystal problem. Our engineers will be glad to make recommendations, at no obligation to you.

"Visit Booth 2-305"
I.R.E. SHOW
March 23-26
Grand Central Palace

Standard Piezo Co.
CARLISLE, PENNSYLVANIA

MINIATURIZATION

Thru constant research, Acme transformer engineers have developed designs, that save pounds and ounces in weight and provide long-life performance. We build miniature transformers by the thousands, each individually performance tested.

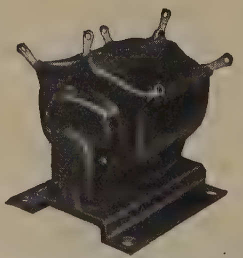


PRESSURIZED SEAL

Here is a transformer design with terminals sealed under pressure with a resilient sleeve that accommodates expansion and contraction of temperature changes.

PLASTIC COATING

This is one of a number of ways that plastic has been adapted to seal transformers or individual coils for service in humid atmospheres or under conditions which breed fungi.



Acme Electric
TRANSFORMERS

ACME ELECTRIC CORPORATION
443 WATER STREET • CUBA, NEW YORK
IN CANADA: ACME ELECTRIC (CANADA) LTD.
824 NOTRE DAME ST., WEST • MONTREAL, CANADA

What to see at the Radio Engineering Show

(Continued from page 178A)

HERMETIC SEAL PRODUCTS CO.

First & Foremost in Miniaturization

29 So. Sixth St.
Newark 7, N.J.
Booth 1-701

SEALED-IN BY HERMETIC HEADERS

Hewlett-Packard Co.
Palo Alto, Calif.
1-509, 511

Audio Oscillators, Television frequency monitor, UHF Signal Generator, Frequency Converter, Calibrated Waveguide Attenuator, Signal Generators, Electronic Frequency Counter.

Hewlett-Packard Co., 395 Page Mill Road, Palo Alto, Calif. 1-509, 511
Audio oscillators, the 200AB and the 200CD, covering a combined frequency range from 5 cps to 600 kc. Television frequency monitor, Model 335E. The new 612A UHF Signal Generator for the design and testing of color television receivers and equipment. The Model 512A Frequency Converter (designed to operate with the 524A Counter for direct measurements of frequencies from 0 cps to 100 mc.) Model 382 Calibrated Waveguide Attenuator. The 618B and 622A Signal Generators extend the frequency range of the H-P line up to 11 kmc. The 522B Electronic Frequency Counter for a variety of measurements for industrial and electronic measurements involving frequency, time, speed, rate, etc.

Hickok Elec. Instrument Co., Cleveland 8, Ohio 2-118
Laboratory and commercial type tube testers; cathode-ray oscilloscopes with DC vertical amplifiers, plus wide and medium band AC amplifiers; portable 3-inch and laboratory type 5-inch instruments; television alignment generators; crystal-controlled marker oscillator generators; complete line of vacuum tube voltmeters; noise generators; television video generators; microvolt generators.

Hi-Q, Div. Aerovex 1-602

Harvey Hubbell, Inc., Bridgeport, Conn. 4-515
Interlock connectors and wiring devices.

Hudson Tool & Die Co.
Newark, N.J.
3-208

Cases, covers, custom metal stampings for electrical, electronics and nucleonic industries.

Kenneth E. Hughes Co., New York 23, N.Y. 4-617
Kenneth E. Hughes Company manufacturers representatives. Division Lead Co., Chicago, Ill., manufacturers of all types of solder, soldering fluxes & soldering chemicals. Other companies whose products we will exhibit are: Advance Electronics, Rochester Electronics, Oryx, J. W. Hobbs Corp., Chemical Electronic Eng., Inc., Highland Engineering Co. & El Mec Labs.

(Continued on page 182A)

VOLTAGE REGULATED POWER SUPPLIES

For Industrial and Research Use

MODEL 1520

THE KEPCO MODEL 1520 FEATURES A REGULATED HIGH VOLTAGE POWER SUPPLY WITH EXCELLENT REGULATION, LOW RIPPLE CONTENT AND LOW OUTPUT IMPEDANCE.

SPECIFICATIONS

OUTPUT VOLTAGE DC: 0-1500 volts continuously variable.

OUTPUT CURRENT DC: 0-200 milliamperes continuous duty.

REGULATION: In the range 30-1500 volts the output voltage variation is less than ½% for both line fluctuation from 105-125 volts and load variation from minimum to maximum current.

RIPPLE VOLTAGE: Less than 20 millivolts.

FUSE PROTECTION: Input and output fuses on front panel. Time delay relay is included to protect rectifier tubes.

POWER REQUIREMENTS: 105-125 volts, 50-60 cycles.

OUTPUT TERMINATIONS: DC terminals are clearly marked on the front panel. Either positive or negative terminal of the supply may be grounded. DC terminals are isolated from the chassis. A binding post mounted on the front panel is available for connecting to the chassis. All terminals are also brought out at the back of the chassis.

METERS: Voltmeter: 0-1500 volts, 4″ rectangular.
Milliameter: 0-200 milliamperes, 4″ rectangular.

PHYSICAL SPECIFICATIONS: Cabinet height 22¾″, width 21¾″, depth 15¼″, color gray, panel engraved. Rack panel height is 21″, width 19″.

CONTROLS: Power on-off switch, HV on-off switch, HV control.

KEPCO

RESEARCH • MANUFACTURING
KEPCO
Laboratories

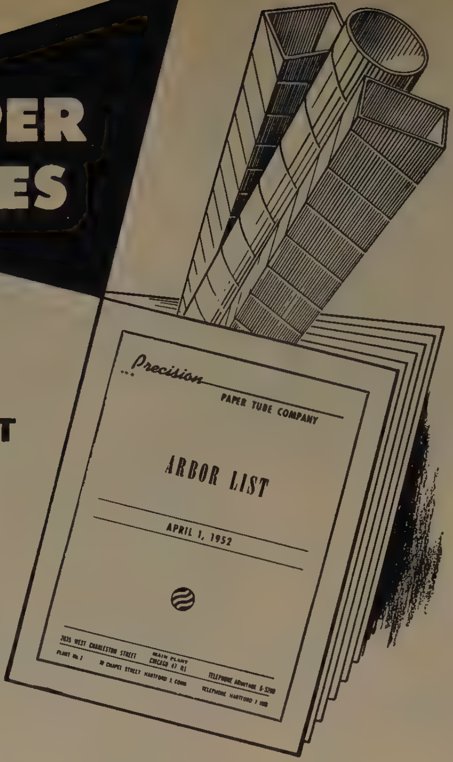
KEPCO LABORATORIES

131-38 SANFORD AVENUE • FLUSHING 55, NEW YORK

Complete catalogue available upon request . . . write dept. A-1

VISIT KEPCO BOOTH NOS. 4-406 and 4-408 AT THE I.R.E. SHOW

PRECISION PAPER TUBES


Precision
PAPER TUBE COMPANY
ARBOR LIST
APRIL 1, 1952
2035 WEST CHARLESTON STREET
MAIN PLANT CHICAGO 47 ILL
TELEPHONE ARMITAGE 6-5200
PLANT No. 2
79 CHAPEL STREET HARTFORD 1 CONN
TELEPHONE HARTFORD 7 1831

any shape . . . length . . .
ID or OD . . . to meet
your specific requirements

SEND FOR ARBOR LIST

Free to you upon request . . . lists over 1500 sizes . . . all promptly available. A free sample is also yours for the asking . . . just send your specifications.

Precision Paper Tubes are spiral-wound of finest dielectric kraft, fish paper, cellulose acetate, or combinations.

Write us today!

PRECISION
PRECISION PAPER TUBE CO.
2051 W. Charleston St. Chicago 47, Ill.
Plant No. 2: 79 Chapel St., Hartford, Conn.
Also Mfrs. of Precision Bobbins

New UHF SWEEP GENERATOR
for UHF TV Production Testing

TYPE 1211

The Type 1211 UHF Sweep Generator has been specifically designed to rapidly and accurately align UHF Television heads, converters and complete receivers,

SPECIFICATIONS

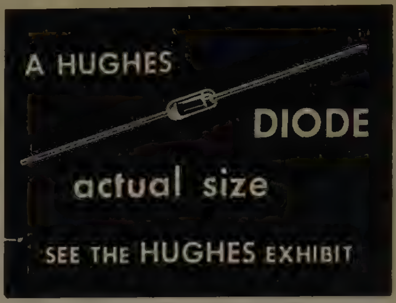
FREQUENCY COVERAGE: 450 to 900 MC. Dial calibrated in 36 MC steps. **BANDWIDTH:** Constant bandwidth of 50 MC over entire spectrum. Can be adjusted to narrower bandwiths, with internal controls. **MARKERS:** Pulse type crystal controlled accurate to 0.02% spaced 36 MC throughout the 450 to 900 MC spectrum. **OUTPUT:** At least 1 volt across a 75 ohm load. **ATTENUATOR:** Electrostatically coupled piston type, range approximately 80 db. **AUXILIARY OUTPUT SIGNALS:** 1. Automatically phased sine sweep for X axis of scope. 2. Marker pulses either plus or minus polarity, continuously variable in amplitude.

PRICE $950.00 F.O.B. PLANT

Manufacturers of a Complete Line of TV Test Equipment
TIC
Tel-Instrument Co. Inc.
50 PATERSON AVENUE • EAST RUTHERFORD, N. J.

What to see at the Radio Engineering Show

(Continued from page 180A)


A HUGHES DIODE actual size
SEE THE HUGHES EXHIBIT

Hughes Aircraft Co., Culver City, Calif. 4-814
Semiconductor products—germanium diodes—Eight new RTMA types of high conductance diodes; higher forward currents combined with higher back resistance than ever before available in commercial quantity. UHF diodes. Nine RTMA types of general purpose diodes with high back resistance. Diodes classified to customer specifications.

HYCOR
Company, Inc.
North Hollywood, Calif.
3-309

New plastic encapsulated toroid coils and series "H" plastic encapsulated precision wire wound resistors, in addition Hycor will display the latest in wave filters designed for precision applications. Technical inquiries will be answered at the booth.

Hytron Radio & Electronics Co. Division of CBS, Inc.
Danvers, Mass.
2-316 & 317

Radio receiving tubes, television receiving tubes, C-R tubes, transmitting tubes, special purpose tubes.

Illinois Condenser Co., Chicago 22, Ill. 4-222
Fixed Capacitors.

Indiana Steel Products Co., Valparaiso, Ind. 2-208
A new ceramic permanent magnet material with unusually high coercive force and very high specific resistivity, permitting its use in high-frequency fields, will be introduced. Also on display: Alnico permanent magnets, Cunife permanent magnets, steel permanent magnets, ion traps and radar magnets.

Visit "INDUSTRIAL" at BOOTH #2-101
for

- Laminated Tube Sockets
- Terminal Strips
- Wired Assemblies
- Metal or Bakelite Stampings
- Terminal Board Assemblies
- Screw Machine Parts

NEW ITEMS
Tuner Strips, Sockets, and Brackets for UHF

INDUSTRIAL HARDWARE MFG. CO., INC.
109 Prince Street, New York 12, N.Y.
Phone: ORegon 7-1881

Industrial Products Co., Danbury, Conn. 2-320 & 321
Connectors and RF Components.

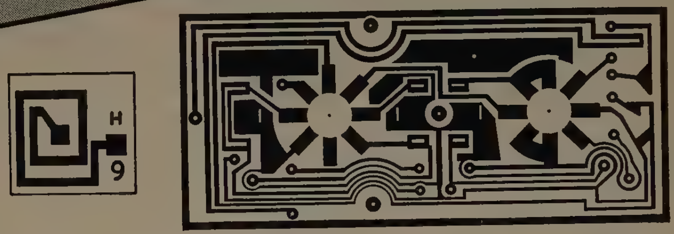
Industrial Tape Corp., New Brunswick, N.J. 4-607
Pressure Sensitive Electrical Tapes vinyl, cellulose acetate, paper and cloth tapes.

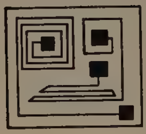
Industrial Television, Inc., Clifton, N.J. 3-509
Oscilloscopes, Field Strength Meters.

(Continued on page 184A)

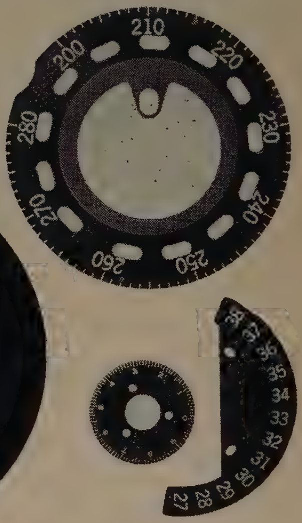
PREMIER · · 40 YEARS OF *PLUS-value* for your ETCHED and LITHOGRAPHED METAL DIALS and PANELS

PREMIER METAL ETCHING offers you complete facilities under one roof to etch, die cut, recess and pierce to close tolerances on all dielectrics, clad with copper, brass, aluminum, silver, nickel or steel.





Etched Circuitry



Fluorescent Dials

PREMIER METAL ETCHING COMPANY

QUALITY PRODUCTS SINCE 1910

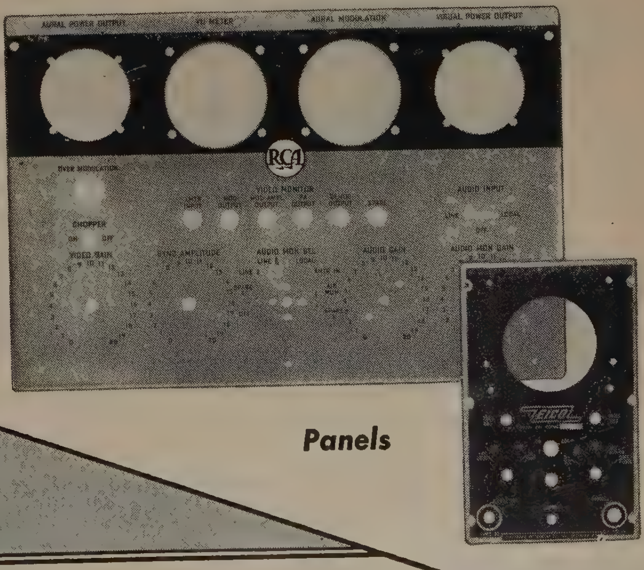
21-03 44th AVENUE, LONG ISLAND CITY 1, N. Y.
Phone STillwell 4-7605

Branch Offices:

PHILADELPHIA, Pa. 593 Drexel Bldg. • BOSTON, Massachusetts
PLAINVILLE, Conn. 128 Bohemia St. • BUFFALO, N. Y. 1807 Elmwood Av.
DETROIT 2, Mich. 604 Fisher Bldg. • CHICAGO 40, Ill. 4554 Broadway
TOWSON 4, Md. P. O. Box 6844 • PITTSBURGH 30, Pa. Box 2014

PREMIER PRODUCTS are distinguished by sharply defined markings, close tolerance calibrations, and accurately positioned holes and lettering. Premier has complete and centralized facilities for producing finished units up to 2" x 36".

NAME PLATES — DIALS FOR INSTRUMENTS, WATCHES & CLOCKS — RADIO - ELECTRONIC PANELS — GAUGES — RULERS — PLAQUES — ETCHED CIRCUITS



Panels

See us at the IRE Show-Booth 4-710

NEW SYSTEM Accurately measures VSWR from 1.02 to 100/1

ROLLIN

DOUBLE PROBE SYSTEM

REFERENCE LABORATORY STANDARD

PRECISION SLOTTED LINE & VSWR INDICATOR

MEASURES IMPEDANCE • VSWR RELATIVE POWER

100 MC TO ABOVE 1000 MC

SWR INDICATOR—STABLE SENSITIVE 1000 CYCLE NEGATIVE FEED BACK AMPLIFIER FLAT TOP SELECTIVITY.

NEGLIGIBLE REFLECTIONS

PIN POINT TYPE PROBE

"HARDWAYS" PRECISION HANDWORKED SURFACE

MODEL 62

MIN. GENERATOR RF. POWER REQ. 2-20 MILLIWATTS

- Full scale VSWR ranges: 1.1/1 - 4.0/1 - 10./1 and to 100/1 using included calibrated probe depth attenuators.
- Differential probe system for accurate measurement of low VSWR.
- Useable electrical probe travel 150 centimeters (½ wave at 100 mc/s).
- Removable end tapers exhibit negligible impedance transformation—under 1%.
- Residual VSWR under 1%—voltage uniformity ±0.5% or better—mechanical tolerances held to 0.2%.
- Machine engraved centimeter scale and vernier (Starrett) measures probe travel to 0.1 millimeter accurate to 0.01mm.
- Continuously adjustable probe depth 0—.500" calibrated in .001" steps. Permits measurements of relative power and maintenance of square law crystal characteristic.

ROLLIN

THE ROLLIN COMPANY
2010 LINCOLN AVE. • PASADENA 3, CALIFORNIA

What to see at the Radio Engineering Show

(Continued from page 182A)

Inet Inc., Los Angeles, Calif. 4-423
Power Supplies: High, Medium and Low Voltage, Voltage Regulated Rectified power sources—Magnivolt.

Instrument Specialties Company, Inc.
Little Falls, N.J.
3-110

Standard Beryllium Copper finger contact strips and rings available from stock. Custom made beryllium copper components to order.

Instruments Publishing Co., Inc., Pittsburgh 12, Pa. 2-108
Instruments—The Magazine of Measurement and Control; The Instruments Index; Instrument Manufacturing; The Instrument Manufacturing Guide; Handbook of Measurement and Control; Books Published and Sold by Instruments Publishing Company.

Insuline Corp. of America
36-02 35th Avenue
Long Island City 1, N.Y.
2-202

Electronic Assemblies, Electronic Components, Metal Housings, Test Equipment, UHF-VHF Antennas, Special facilities for Government contract needs.

Insuline Corp. of America, Long Island City 1, N.Y. 2-202
Electronic assemblies, Electronic Components, Metal Housings, Test Equipment, UHF-VHF Antennas, Special Facilities for Government Contract Needs, JAN type plugs, jacks, terminal strips, special metal fabrications.

International Nickel Co., Inc., New York 5, N.Y. 1-521
Nickel and Nickel Alloys as used by the Industry.

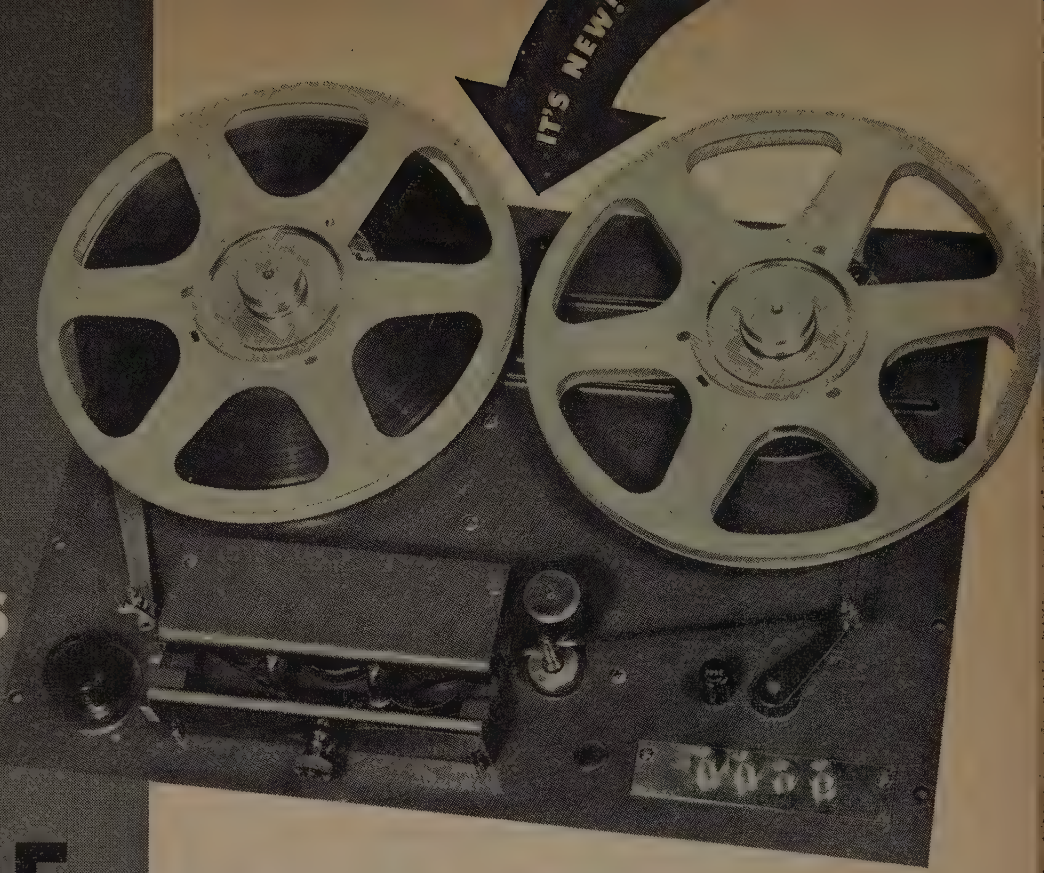
International Resistance Co.
Philadelphia 8, Pa.
1-110

Fixed & Variable Carbon Resistors, Fixed & Variable wire wound resistors, composition carbon resistors, deposited carbon resistors, high voltage carbon resistors, high frequency resistors, power resistors, hermetically sealed terminals, miniature selenium rectifiers, boron carbon resistors.

J-B-T Instruments, Inc., New Haven 8, Conn. 2-130
Vibrating Reed Frequency Meters, Panel or portable, including 1½" and 3½" sealed types, 60 and 400 cycles combination for audio-oscillators, and new 2-cycle increment models for 400 cycle bands; Elapsed Time Meters, including 400 cycle sealed model, others in combination with frequency meters; Lever Action Switches, 3 or 4 position, 1 or 2 deck; Rotary Selector Switches, 14 and 20 position types, instrument quality, laminated or fully-enclosed molded models; Switch Kits for special models; Pyrometers and other temperature measuring instruments and accessories. Also 2" electrical Instruments: Shurite panel and pocket A.C. and D.C. voltmeters, milliammeters, etc. made by subsidiary.

JFD Manufacturing Co., Inc., Brooklyn 4, N.Y. 2-134
TV antennas and accessories. Variable piston type capacitors.

(Continued on page 186A)



puts other tape recorders in the SHADE...the PRESTO RC-11

PRESTO introduces a precision-engineered tape recorder with a radical new type of construction!

Featuring a self-contained capstan drive unit, the PRESTO RC-11 provides durability, flexibility and rapid maintenance heretofore unheard of in tape equipment. Motor, fly wheel, capstan shaft, pressure pulley and solenoid are all pre-mounted on a cast aluminum sub-assembly . . . a complete working unit quickly removable for service or replacement.

A heavy, ribbed, cast aluminum panel designed for rack or case mounting supports all other components. Overall durable construction gives additional reinforcement and protection during shipping and adds years to the life of the machine.

In terms of performance and operational case, the RC-11 also steps out front. This new recorder, with complete push button operation, automatic microswitch in case of tape breakage and a reel capacity of 10½ inches, is an engineer's delight.

The combination of advanced design and engineering in the RC-11 puts ordinary tape recorders in the shade . . . makes this instrument an *investment,* not an expenditure. Ask your PRESTO distributor for full information on this important development in tape recorder design . . . the *all new* RC-11.

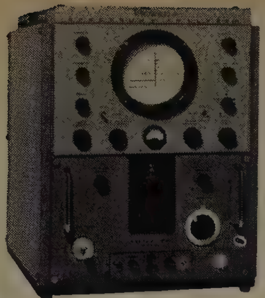
The "unitized" construction of the Presto RC-11

. . . allows a complete flexibility in the manufacture of various types of instruments. By the simple rearrangement of components the RC-11 becomes a high fidelity recorder, a dual track, bi-directional recorder or reproducer or a long-playing reproducer with automatic tape reversal.

PRESTO RECORDING CORPORATION
PARAMUS, NEW JERSEY

Export Division: 25 Warren Street, New York 7, N. Y.
Canadian Division: Walter P. Downs, Ltd., Dominion Square Bldg., Montreal

WORLD'S LARGEST MANUFACTURER OF PRECISION RECORDING EQUIPMENT AND DISCS



The Operating Frequencies YOU Need

VECTRON'S NEW Microwave SPECTRUM ANALYZER

. . . provides a wide choice of operating frequencies in a single, compact unit.

. . . eliminates the unnecessary bulk and extra cost of equipment which covers large areas in bands you never use.

SPECIFIC BAND COVERAGE to fulfill your particular requirements is readily available with separate, interchangeable R. F. Heads.

INTERCHANGEABLE R. F. HEADS are easily installed and removed from the Vectron chassis. Separate heads are supplied in convenient, protective storage cases. S-band and X-band Heads from stock; others available for early delivery.

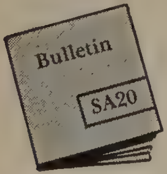
For Microwave Radar and Communications Equipment
The Vectron SA20 Spectrum Analyzer presents visually the frequency distribution spectrum of the power output of pulsed or CW microwave oscillators and can be used as a sensitive RF detector for checks and measurements in the design, production and maintenance of microwave radar and communications equipment and components.

FEATURES

- Large, clear 5" oscilloscope pattern
- Standard bezel to accept camera, hood or filter
- Minimum number of controls . . . maximum operating convenience
- Double conversion assures I. F. alignment stability
- Built in regulated supply for Klystron oscillators
- Easy access for maintenance or adjustment

SPECIFICATIONS

Overall Gain — 130 decibels.
Sensitivity—Approx. —60dbm for 1 usec. pulse width.
IF Bandwidth — Choice of 50 kc, recommended for CW and 0.2 to 2 usec. pulse widths, or 20 kc. bandwidth to 5 usec.
Sweep Frequency — 10 to 30 cps standard — available to 2 cps and with long persistence tube.
Power Requirements — 105 to 125 volts. 60 cycles.



Vectron's development program includes additional R. F. Heads to cover microwave frequencies newly opened for military and civilian use. For information on these additional R. F. Heads and for complete engineering and operating data, send for Bulletin SA20. Write today and be sure to specify the operating frequencies you need.

VECTRON also offers custom design and production facilities for development and contract manufacture of servo-mechanisms, communication networks and filters, gyro-mechanisms, electronic systems, electro-mechanical equipment and instrumentation. Write us today and specify your requirements.

VECTRON, inc.
Electronic and Electro-Mechanical Equipment
402 MAIN STREET, WALTHAM 54, MASS.

See Us at Booth 3-411, IRE Show, March 23-26

What to see at the Radio Engineering Show

(Continued from page 184A)

Jeffers Electronics, Pa. 4-127
See: Speer Resistor

Jennings Radio Mfg. Co.
San Jose, Calif.
4-211

Our development laboratory is available to design and produce units for specialized applications.

Jennings Radio Mfg. Co., San Jose (8), Calif. 4-211
Fixed and variable types of vacuum capacitors; vacuum switches and relays, vacuum capacitance voltage dividers; vacuum feed-thru capacitors; other vacuum units for specialized applications.

Jensen Mfg. Co., Chicago 38, Ill. 3-506 & 507
Loudspeakers, TV and Radio Components. parts include: coils, resistors, condensers, deflection yokes, fly-back transformers.

Jerrold Electronics Corp., Philadelphia, Pa. 4-618
Multiple Television Distribution outlet systems and complete associated equipment.

Jerrold Electronics Corp.
Philadelphia 46, Pa.
4-618

- Community television antenna systems
- Television field strength meter
- Variable and fixed rf attenuators
- Master television antenna systems for hotels, apartments, motels
- rf preamplifiers and fixed frequency UHF converters.

Howard B. Jones Div., Cinch Mfg. Corp., Chicago 24, Ill. 2-505 & 506
Electrical Connecting Devices.

Kalbfell Labs., Inc.
San Diego 10, Calif.
2-206 & 207

Displaying a revolutionary new line of chopper stabilized power supplies—high powered standard cells, with extremely low output impedance and excellent long-time stability. Also standard line of Logatens—non-linear attenuators; Twin-T Filters; Peaked Amplifiers; Servo-Stabilizers; Electronic Thermostats; Logarithmic Time Bases; Plug-In Amplifiers; Micro-Mikers; Decade Amplifiers; Automatic Potentiometer Positioners.

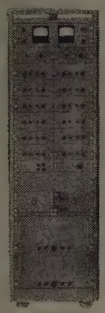
Karp Metal Products Company, Inc.
Brooklyn 20, N.Y.
1-510 & 512

On display are cabinets, housings and enclosures especially fabricated for the electronics industry. See how Karp's use of the latest sheet metal fabrication and welding techniques renders sturdy, attractive and functional housings to protect your most sensitive instruments.

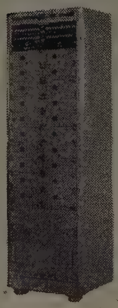
Be sure to visit all four floors!

(Continued on page 188A)

Preview of a New Precision Analog Computer for Solving Problems in Dynamics . . .



Amplifier Group Type 16-31B 24 contact - stabilized d-c amplifiers.



MultiplierGroup Type 16 - 31A 20 multiplying channels.

Resolver Group Type 16 - 31D 4 resolving channels. 6 amplifier channels.

Servo Group Type 16 - 31G 2 resolving channels. 4 multiplying channels.

True, you'll find many analog computer systems on the market. However, we have spent a great deal of time developing a system which we feel does a more effective, more efficient job with the highest degree of accuracy. Here are the reasons:

New 20-channel servo-mechanical multiplier in which several channels may be used as incremental function generators.

New centralized control from operating console for greater flexibility.

New automatic select and set keyboard-operated attenuator system for ease of operation.

New controlled environment to insure maximum accuracy at all times.

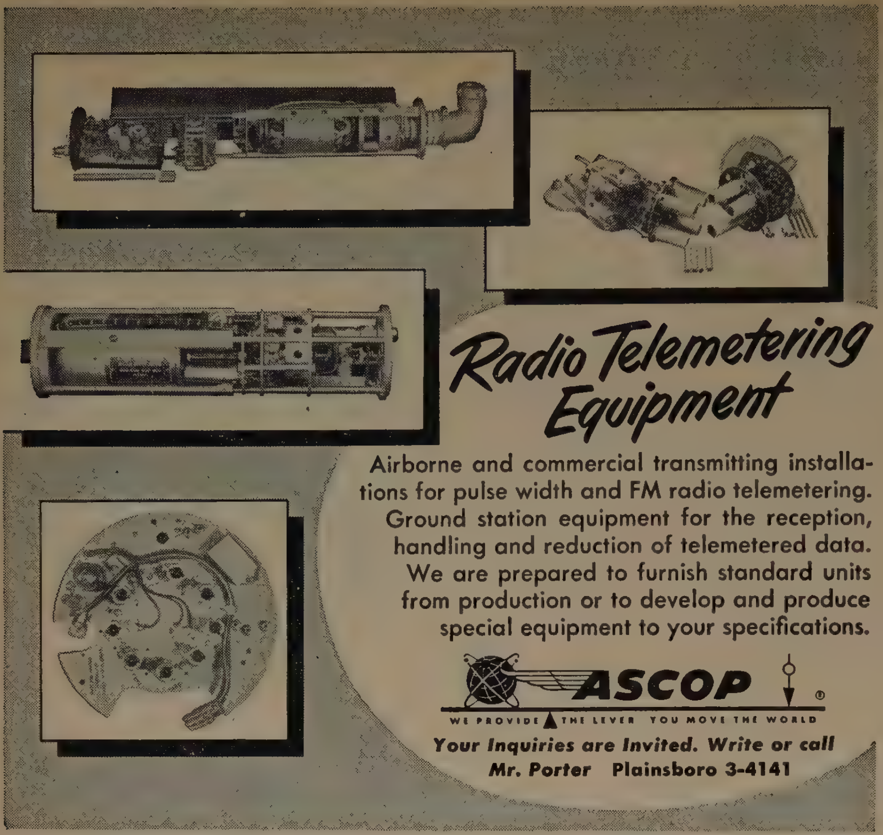
New grounded metal problem board eliminates errors due to leakages between terminals.

For more information on this system, write for our Components Book. Address inquiries to:

ELECTRONIC ASSOCIATES, INCORPORATED
COMMERCIAL SALES DEPARTMENT
200 LONG BRANCH AVENUE
LONG BRANCH, NEW JERSEY

ELECTRONIC
ASSOCIATES
Incorporated

See this new system at Booths 1-114, 1-115—I.R.E. Show, Grand Central Palace



Radio Telemetering Equipment

Airborne and commercial transmitting installations for pulse width and FM radio telemetering. Ground station equipment for the reception, handling and reduction of telemetered data. We are prepared to furnish standard units from production or to develop and produce special equipment to your specifications.

ASCOP®
WE PROVIDE THE LEVER YOU MOVE THE WORLD

Your Inquiries are Invited. Write or call
Mr. Porter Plainsboro 3-4141

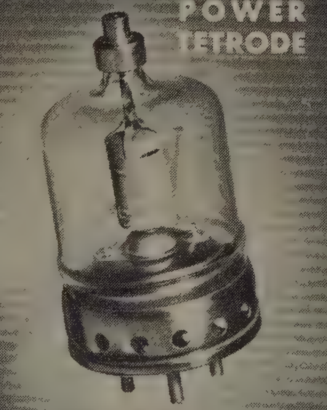
APPLIED SCIENCE CORPORATION OF PRINCETON

Also: High Speed Sampling Switches and Special Components and Equipment

P. O. Box 44, Princeton, New Jersey

See Us at Booth 4-806, Grand Central Palace, Radio Engineering Show, March 23-26

Now
PL-4D21
POWER TETRODE

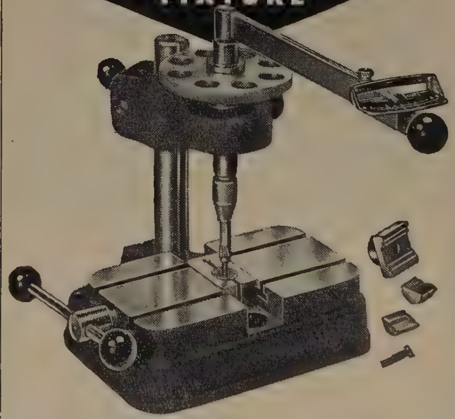


[illegible] DISSIPATION.
FULL RATINGS TO 120 Mc.
HIGH OVERLOAD CAPABILITIES.
AVAILABLE IMMEDIATELY.

For data, Write:

PENTA LABORATORIES INC.
216 North Milpas Street
SANTA BARBARA, CALIFORNIA

STURTEVANT
TORQUE TESTING FIXTURE



FOR TESTING Screws, tapping-screws—all types of threaded fasteners; threaded parts and threaded connections.

FOR MANUFACTURERS
DESIGNERS
INSPECTORS
TOOL ENGINEERS
LABORATORIES and for
PRODUCT CONTROL
in assembly.

Capacities: (0-200 in. lbs.) or (0-150 ft. lbs.)

Write for Bulletin TTF

P. A. STURTEVANT CO.
ADDISON QUALITY ILLINOIS

What to see at the Radio Engineering Show

(Continued from page 186A)

Kay Electric Co.
Pine Brook, N.J.
1-401

Electronic Test and Measuring Instruments.

Kenyon Transformer Company, Inc.
New York 59, N.Y.
1-615

Displaying up to date models of specially engineered transformers. This year the emphasis will be on small oil-filled units, and the new "Ken-seal" molded units. Various other types of Kenyon components will be displayed also.

Voltage Regulated Power Supplies
4-406 & 408

For Industrial & Research, Excellent Regulation & Stabilization, Low Output Impedance. Low Ripple Content.

KEPCO LABORATORIES
131-38 Sanford Ave., Flushing 55, N.Y.

Kepco Laboratories, Flushing 55, N.Y. 4-406 & 408
Super Voltage Regulated Power Supply DC Voltage Regulated to 0.01%). Will show 16 of 30 Standard DC Voltage Regulated Power Supplies. Low Voltage High and Low Current—Medium Voltage—High & Low Current. High Voltage—High & Low Current.

Kester Solder Co.
Chicago 39, Ill.
2-411

Featuring Kester " 'Solderforms' in Action," this firm's booth shows how pre-formed solder pieces are used by various industries to cut down on production labor and speed up assembly. All the special "Solderform" shapes are presented, including rings, discs, pellets, washers, and springs. Various Flux-Core Solders will also be displayed.

Ketay Manufacturing Corp., N.Y. 4-711
The revolutionary Ketay designed miniature synchro has set new standards for the industry. Other mass-produced Ketay miniatures include servo motors, high precision resolvers, and high-performance resolver amplifiers.

Ketay Manufacturing Corp.
555 Broadway, New York 12, N.Y.
4-711

Ketay
Synchros
Servos
Resolvers
Magnetic Amplifiers
Electronic Equipment

(Continued on page 190A)

We grew to help you

**
*
← BIG, NEW 2-PLANT SIZE →
50% more seamless nickel cathode capacity

Of this we are sure: you made us what we are today. You demanded so many of our seamless nickel cathodes that we had to add capacity. We did. We built another plant—this time at Wapakoneta, Ohio—increasing our seamless nickel cathode output by 50%.

Other familiar characteristics of Superior service remain—the desire to help you with your problems, the experience of skilled tube-fabricators, and quality-controlled manufacture.

Take advantage of Superior service and capacity now.

*Main Superior Tube plant at Norristown, Pa.
**NEW Superior Tube plant at Wapakoneta, Ohio

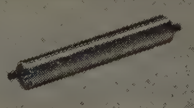
SEAMLESS NICKEL CATHODES

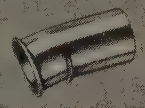
Representative size and shape specifications in current production

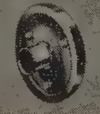
Type	Bead	O.D.	Wall Thickness	Length
ROUND	None	.015″	.002″	25.4 mm
ROUND	None	.121″	.0035″	8.0 mm
ROUND	Single	.045″	.002″	27 mm
ROUND	Double	.025″	.002″	28.5 mm
OVAL	Double	.025″x.048″	.003″	12 mm
OVAL	Single	.045″x.149″	.002″	31 mm
OVAL	Single	.025″x.048″	.003″	12 mm
ELLIPTICAL	Double	.025″x.048″	.003″	11 mm
RECTANGLE	Single	.030″x.0975″	.002″	11 mm
RECTANGLE	Double	.040″x.132″	.004″	33.4 mm

Many other types of nickel cathodes—made in Lockseam† from nickel strip, disc cathodes—and a wide variety of anodes, grid cups and other tubular fabricated parts are available from Superior. For information and Free Bulletin address Superior Tube Company, Electronics Division, 2506 Germantown Avenue, Norristown, Pa.

SeamlessNickelCathode—Round, flanged one end. .115″ O.D. x .105″ I.D. .180″ long.


Lockseam† Nickel Cathode Plate, .170″ O.D. x .005″ wall. 1″ long.


Weldrawn‡ 305 Stainless Steel Anode Rolled and Bent 10°. .499″ I.D. x .010″ wall x 1.050″ long.


Disc Cathode .121″ O.D. .312″ long.

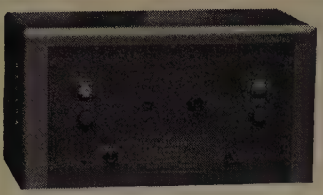
Superior
THE BIG NAME IN SMALL TUBING

All analyses .010″ to ⅝″ O.D.

Certain analyses (.035″Max. wall) up to 1⅝″ O.D.

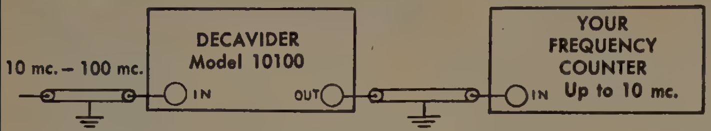
† Manufactured under U.S. Patents
‡ Trademark Reg. U.S. Pat. Off.

EXTEND THE RANGE OF STANDARD FREQUENCY COUNTERS WITH THE DECAVIDERS



- NO LOSS OF ACCURACY
- LESS SIGNAL LEVEL REQUIRED

(Gains of up to 1000 : 1 with some models)



Read your counter and add specified fixed frequency

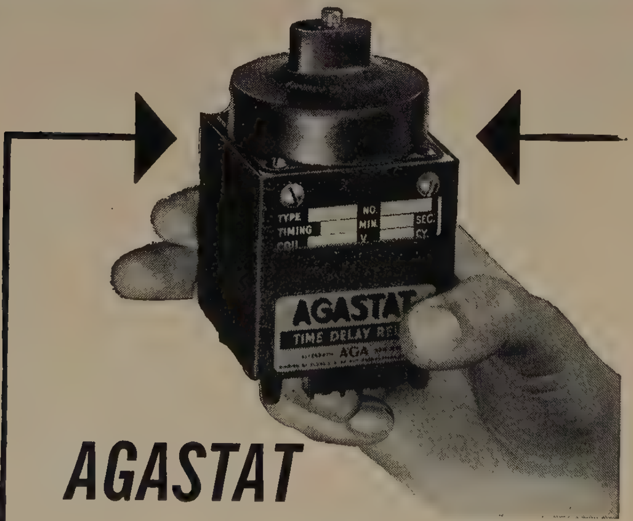
Frequency Counter Range	DECAVIDER Model No.	Extends Range to	Price f.o.b Caldwell, N. J.
Up to 10 mc	1020	10 mc.— 20 mc.	$295.00
Up to 10 mc	10100	10 mc.—100 mc. (9 ranges)	495.00
Up to 1 mc	110	1 mc.— 10 mc. (9 ranges)	395.00
Up to 100 kc	10	100 kc. — 10 mc. (10 ranges)	545.00

NEW HIGH GAIN (50 DB) UNITS FOR LOW LEVEL (5 MILLIVOLT OR LESS) PRECISION FREQUENCY MEASUREMENTS

Decavider for use with any single 10 mc band in range from 20-250 mc – $495.00. Decavider for use with any single 10 mc band above 250 mc—price upon request.

BOOTH NO. 4-905

DECADE INSTRUMENT CO. Box 153, Caldwell, N. J.
Phone CAldwell 6-4258



AGASTAT

Compact . . . Dust-Proof

TIME DELAY RELAYS

solenoid actuated—pneumatically timed

Introduces time delays into a-c or d-c circuits. Easily adjusted to provide delays ranging from 0.1 second to five or more minutes.

The AGASTAT is small, light, and operates in any position. Dust-proof timing chamber assures long operating life with a minimum of maintenance.

Write for Bulletin.
Dept. A1-37,

AGA

Division of Elastic Stop Nut Corporation of America
1027 Newark Avenue, Elizabeth 3, New Jersey

What to see at the Radio Engineering Show

(Continued from page 188A)

Keystone Products Co., Union City, N.J. 4-609
Custom built aircraft and special purpose transformers. A complete servo set-up illustrating the MOTOMAG, a new packaged magnetic amplifier.

Kimble Glass Co., Toledo 1, Ohio. 1-124 & 125
Makers of all-glass rectangular cathode-ray tube bulbs. Exhibit will show how the glass industry has progressively reduced weight and increased sizes of bulbs. Exhibit will also show the basis of how all-glass bulbs are manufactured.

Kings Electronics Company
Tuckahoe 7, N.Y.

2-204

Coaxial connectors, rf fittings, microwave assemblies, waveguide components, antennas, test sets.

VISIT OUR EXHIBIT

JK PRODUCTS

BOOTH SPACE #2-109

JAMES KNIGHTS COMPANY
SANDWICH, ILLINOIS

James Knights Co., Sandwich, Ill. 2-109
Quartz crystals and holders: quartz oscillator plate, filter and ultrasonic crystals; phenolic, hermetic-sealed holders; ovens of all sizes and capacities; tourmaline and quartz crystals; custom cut and ground; frequency standard; and frequency and modulation monitors.

Krohn-Hite Instrument Co.
Cambridge 39, Mass.

4-301

Audio Oscillators, Ultra-Low Frequency Oscillators, Square wave generators variable band-pass filters. Variable rejection filters, Servo-design filters.

Kulka Electric Mfg. Co., Inc.
Mt. Vernon, N.Y.

2-139

Molded barrier type of terminal blocks, sizes ranging from miniature to a jumbo 90 amps. size. Aircraft and electronic switches made to JAN-S-23 specs. electronic components. Electrical wiring devices, such as receptacles, outlets, plugs, etc. Terminals and solder lugs. Cable assemblies and Harnesses.

Kupfrian Mfg. Co., Binghamton, N.Y. 3-101
Flexible Shaft Couplings, and Flexible Shaft Assemblies for remote control of potentiometers, tuners, switches, repeaters, revolution counters and other instruments and components. Also electrostatic wire shielding, push-pull controls and Universal Joints.

(Continued on page 206A)

ENGINEERS

Systems
Radar
Servo
Computer

You gain MORE with W. L. MAXSON. Top salaries . . . greater opportunities . . . more responsibilities. Advance with W. L. MAXSON.

BACKGROUND: Practical and research experience in Advanced Electronic Circuits and Systems Engineering DESIGN & ANALYSIS, related to: Instrumentation, Fire Control, Communications, Navigation, or Optical Fields. Ability in management & supervision desirable.

If your skills are now being fully utilized in a vital defense industry, please do not apply.

Kindly send resume and salary requirements to:

MAXSON

The W. L. MAXSON Corp.
460 W. 34th ST., NEW YORK 1, N.Y.

PHYSICISTS
and
ELECTRONIC ENGINEERS

Physicists, Junior and Senior Electronic Engineers are needed for employment with expanding research and development laboratory specializing in Instrumentation, Radio Telemetering, Data Handling and Analysis, and special electro-mechanical devices.

Electronic Engineers are needed for design of RF Transmitters and Receivers and Pulse Circuitry.

Physicists are needed for the study of electrical and mechanical properties of sliding contacts including analysis of contact materials, lubricants and vibration damping.

Replies will be held in strictest confidence.

Please send complete resumes to:

ASCOP

WE PROVIDE THE LEVER • YOU MOVE THE WORLD

APPLIED SCIENCE CORP. OF PRINCETON
P.O. Box 44, Princeton, N.J. • Plainsboro 3-4141

POSITIONS OPEN

Location
Kansas City, Mo.

Electronic & Mechanical Engineers

ELECTRONIC ENGINEERS: Must have considerable development experience in radio transmitting and receiving equipment. Ability to fill position of Senior Project Engineer a requisite.

MECHANICAL ENGINEER: Must have development experience in mechanical design of electronic or similar precise equipment. Practical and theoretical knowledge of materials, finishes, sheet metal, and machine shop design are basic requirements. Position is one of considerable responsibility.

SALARY: Open

These positions are permanent.

Write stating educational and professional history direct to:

JAY V. WILCOX, *President*

WILCOX ELECTRIC COMPANY, INC.
1400 Chestnut St., Kansas City 1, Mo.

Dependable communications since 1931

An Opportunity

is offered for intelligent, imaginative engineers and scientists to join the staff of a progressive and self-sustaining, university-affiliated research and development laboratory. We are desirous of expanding our permanent staff in such fields as electronic instrumentation, missile guidance, microwave applications, design of special-purpose electronic computers, and in various other applied research fields of electronics and physics.

Salary structure and benefit programs are on a par with industry. In addition, there are many tangible advantages, such as our self-sponsored internal research policy, of interest to men with ingenuity and initiative.

CORNELL AERONAUTICAL LABORATORY, INC.
BUFFALO 21, NEW YORK

Career Opportunities

●

ENGINEERS AND PHYSICISTS

Desiring the challenge of interesting, diversified, important projects—

Wishing to work with congenial associates and modern equipment and facilities—

Seeking permanence of affiliation with a leading company and steady advancement—

Will find these in a career here at GENERAL MOTORS.

●

Positions now are open in ADVANCED DEVELOPMENT and PRODUCT DESIGN, INDUSTRIAL ENGINEERING, TEST and TEST EQUIPMENT DEVELOPMENT.

- **COMMERCIAL AUTOMOBILE RADIO**
  - **MILITARY RADIO, RADAR AND ELECTRONIC EQUIPMENT**
    - **ELECTRONIC COMPONENTS**
      - **TRANSISTORS AND TRANSISTOR AND VACUUM TUBE APPLICATIONS**
        - **INTRICATE MECHANISMS such as tuners, telemetering, mechanical linkages, controls, etc.**
          - **ACOUSTICS—loud speakers, etc.**

●

Inquiries invited from recent and prospective graduates as well as experienced men with bachelors or advanced degrees in physics, electrical or mechanical engineering, chemistry, metallurgy.

Salary increases based on merit and initiative.

Vacations with pay, complete insurance and retirement programs.

Location is in a low living cost center.

Relocation expenses paid for those hired.

●

All inquiries held in confidence and answered—WRITE or APPLY to

DELCO RADIO DIVISION
GENERAL MOTORS CORPORATION
Kokomo, Indiana

What to see at the Radio Engineering Show

(Continued from page 190A)

Laboratory for Electronics, Inc.
Boston 14, Mass.
4-105 & 106

- LFE oscilloscopes
- Nuclear Resonance magnetometers
- Stable microwave oscillators
- Packaged circuits.

Lambda Electronics Corp.
Corona 63, L.I., N.Y.

3-501

Laboratory Power Supplies.

The La Pointe-Plascomold Corp., Rockville, Conn. 4-503
VEE-D-X UHF Antennas—UHF-VHF Antenna divider networks for incorporation in your TV receiver designs. UHF-VHF divider networks for TV antenna installations. Press-Wireless—radar voltage dividers, slotted line, electrical design.

Lavoie Laboratories, Inc.
Morganville, N.J.
1-126 & 127

Exhibit will feature a new design in radar scanners hydraulically actuated and light in weight; a fast acting hydraulic system for transmitters and communication systems etc.; frequency measuring and calibrating equipment and other new developments.

G. H. Leland, Inc.
Dayton, Ohio
4-820

Ledex Rotary Solenoids, six basic models with various degrees of rotation and torque values up to 50 pound-inches. Ledex Circuit Selectors, 8, 10, 12, 18, and 24 positions. Ledex Relays, stopping and homing. Bridge Type Rectifiers for use with Ledex products.

Linde Air Products Co., Div. Union Carbide & Carbon Co., New York 17, N.Y. 1-514-516 & 518
Xenon, Krypton, Argon, Helium, Neon, and Rare Gas Mixtures as well as Synthetic Sapphire Boules, Rods, and Balls.

Littelfuse, Inc.
Des Plaines, Ill.
1-702

Circuit protection devices including glass enclosed cartridge fuses and related accessories, such as fuse holders for both civilian and government use, circuit breakers, mercury switches and blown fuse indicators.

(Continued on page 208A)

Jets, and your future at

BOEING

THERE'S a limitless future for you in jet aircraft. And Boeing, through the fighter-fast B-47 and the great new B-52, has *more* experience designing, building and flying multi-jet aircraft than any other company—here or abroad. In addition, Boeing is the first American company to announce a jet transport. You can share this leadership, and the exciting future it promises, by becoming a Boeing engineer. Besides jet aircraft, you'll find great opportunities in other long-term projects such as research in supersonic flight and nuclear-powered aircraft.

Boeing offers careers of tremendous scope to men in virtually ALL branches of engineering (mechanical, civil, electrical, aeronautical and related fields), for aircraft **DESIGN, DEVELOPMENT, PRODUCTION, RESEARCH and TOOLING**; to servo-mechanism and electronics designers and analysts, and physicists and mathematicians with advanced degrees.

Boeing pays you a moving and travel allowance. You can work in either Seattle or Wichita. Both of these cities provide fine fishing, hunting, golf, boating and other recreational facilities—as well as opportunities for specialized advanced training. You'll be proud to say, "I'm a *Boeing* engineer!"

Write today to address below or use coupon

JOHN C. SANDERS, Staff Engineer—Personnel
Dept. J-3
Boeing Airplane Company, Seattle 14, Wash.

Engineering opportunities at Boeing interest me. Please send me further information.

Name ____________________

Address ____________________

City and State ____________________

ENGINEERS

OPPORTUNITIES

WITH

SYLVANIA

Where Product Development Is The Key To Continuing Growth

Product development has always played a major role in Sylvania's operations and is largely responsible for the company's growth to 40 plants throughout the nation. Similarly, Sylvania's Electronics Division is continuing its expansion program to accommodate increased development engineeering and manufacturing activities.

To engineers this means increasing opportunity with this 51 year old leader in the important field of electronics. At the Electronics plants in Woburn, Newton and Ipswich, Massachusetts you will enjoy the unique advantages of small plant operations in suburban areas minutes from the cultural and social activities of Boston. And — with Sylvania's assistance, you may continue your graduate studies at near-by world-famous universities.

Positions available for engineers with the following backgrounds:

MICROWAVE — with graduate work or experience in microwave theory. Positions will involve applications, measurements, or design of electronic test equipment for semi-conductor devices.

MECHANICAL — with experience in the following fields: 1. Design of small parts, tools, and jigs and fixtures. 2. Design of automatic production equipment.

SOLID STATE PHYSICISTS — Ph.D. or equivalent in experience in physics with a specialty in solid states work preferred. Will study electrical and optical behavior of semi-conducting materials.

METALLURGISTS — advanced degree or experience required. Will work on metallurgical preparations of semi-conducting devices.

ELECTRONIC — with graduate work or experience in product or circuit design and development.

Send complete resume to:

Mr. Robert L. Koller

SYLVANIA ELECTRIC

Electronics Division
WOBURN, MASS.

SALES ENGINEER

- ELECTRONIC COUNTERS
- AUTOMATIC CLERICAL SYSTEM
- DATA HANDLING EQUIPMENT
- DIGITAL COMPUTERS
- PRECISION TIMING INSTRUMENTS
- AUTOMATIC MACHINE CONTROL
- FLYING TYPEWRITER

Excellent opportunity for a man with electronic background, mechanical aptitude, and IMAGINATION

Well-established and expanding company

Please send resume of education and experience to Sales Manager.

POTTER INSTRUMENT COMPANY
115 Cutter Mill Road, Great Neck, N.Y.

What to see at the Radio Engineering Show

(Continued from page 206A)

Lord Manufacturing Co., Erie, Pa. 2-124
Shock Mountings for mobile electronic equipment; Temproof Mountings and equipment bases for equipment protection at high and low temperatures; precision type Friction Drive Wheels; Flexible Couplings from 1/50 to 100 H.P.; specialized Flexible Mountings for protection of sensitive equipment; component parts, meters, instruments, etc. New J-5572 Mountings for base-mounted electronic equipment throughout the temperature range from —80 to + 250 F.

M B Manufacturing Co., Inc., New Haven 11, Conn. 2-110
Headquarters for Vibration Equipment (Reproduction-Measurement-Control) exhibits: New Cycling Control Systems, automatic or manual, with vibration exciters to conform to Military Specifications—Vibration Meters and Pickups, including new high temperature model Isomode Isolator Mounts and Isomode Pad.

Machlett Laboratories, Inc.
Springdale, Conn.
1-116 & 117
ML-6256 ML-6257 ML-6258 Three New Coaxial Seal Triodes—2-3kw Output, Water or Forced Air Cooled, Industrial or Broadcast Service. ML-5331 New 10kw Forced Air Cooled Triode, AM Broadcast and Industrial Service. ML-5681 ML-5682 New Standard for High Power, High Frequency Operation Compact, Coaxial Seals, Water Cooled, Industrial and Broadcast Service.

(Continued on page 209A)

ELECTRONIC ENGINEERS WANTED
SOUTHERN CALIFORNIA

Attractive opportunities offered to Engineers experienced in and qualified to design aircraft flush antennas and radomes.

Complete modern facilities for laboratory testing and evaluation available.

Salary dependent upon experience and ability.

Contact Mr. J. C. Buckwalter
Chief Engineer

DOUGLAS AIRCRAFT COMPANY, Inc.
LONG BEACH, CALIFORNIA

GENERAL ELECTRIC...

The Logical Choice for

ENGINEERS
PHYSICISTS
CHEMISTS
METALLURGISTS

A combination of advantages makes General Electric a sound choice when planning your future.

There is the stability of association with one of America's leading industrial organizations; the vast fund of resources and facilities to call upon; the diversity of experience to be gained; the prospects of advancement with a company that believes in and practices promotion-from-within.

Positions are now open in Advanced Development, Design, Field Service and Technical Writing in connection with:

MILITARY RADIO & RADAR
MOBILE COMMUNICATION
MULTIPLEX MICROWAVE COMMUNICATIONS
ELECTRONIC COMPONENTS
TELEVISION, TUBES & ANTENNAS

Bachelor's or advanced degrees in Electrical or Mechanical Engineering, Physics, Metallurgy, or Physical Chemistry and/or experience in electronics industry necessary.

Do not apply, please, if your best skills are being used for vital defense work.

Please send resume to:
Dept. 3-3-P Technical Personnel
ELECTRONICS PARK
GENERAL ELECTRIC
Syracuse, N. Y.

What to see at the Radio Engineering Show

(Continued from page 208A)

Maclen Corp., Washington 17, D.C. 4-810 & 812
Radio communications and navigational equipment. Regulated Power Supplies—aircraft type—direct current 400 cycle Motor Generator sets.

MacLeod & Hanopol, Inc., Charlestown 29, Mass. 4-919
Vacuum tube capacitance meters, megohmmeters, capacitance standards, megohmstandards, High Impact Testing accessories, and samples of contract work.

Magnecord, Inc.
Chicago 10, Ill.

Theatres 3-301-302 & 303

Magnecord Professional Tape Recorders.

Magnetic Amplifiers, Inc.
Affiliate of General Ceramics
New York 55, N.Y.

Booth 4-206

Push-pull magnetic amplifiers; Adjustable magnetic servo amplifiers; Magnetic amplifiers servo systems; Saturable transformers; Demodulators; Magnetic relays; Magnetic voltage regulators.

Magnetics, Inc., Butler, Pa. 4-616
Will exhibit tape wound cores of all high permeability magnetic materials. Tape thickness ranges from .014" to .000125", including ultra-thin cores for computer and high frequency applications. Also reactors and specialized magnetic amplifier components and assemblies.

D. E. Makepeace Co.
Attleboro, Mass.
3-401

Laminated precious metals, contact metals, formed contacts, wave guide tubing, wave guide plumbing, shim stock, silver solders, collector rings, potentiometer rings, brushes, etc.

P. R. Mallory & Co., Inc.
Indianapolis 6, Ind.
1-515 & 517

Will display a wide variety of new electrical and electronic components. Of special interest to TV converter and all-channel receiver Manufacturers will be the three-section, variable inductance, Mallory UHF Tuner which covers a range of 470 and 890 megacycles with excellent selectivity over the entire band.

Be sure to visit all four floors!

(Continued on page 210A)

only TURBO

miniaturization wire stands temperatures from -55°c to +105°c . . . . . AND MEETS OR BEATS ALL OTHER REQUIREMENTS OF JAN-C-76 AND MIL-W-5086

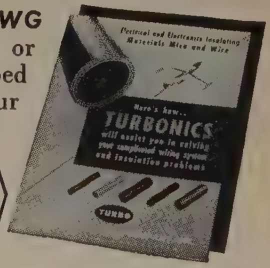
ACTUAL SIZE
of a 22 GAUGE (7/30)
VINYL INS. - 0.0075"
NYLON INS. - 0.0025"
MAX. O.D. - 0.0058"

PROVE TO YOURSELF that wire does not need bulky insulation to stand extreme temperatures, or give you insulating values above 1000 megohms per 1000 ft.

SEND FOR A SAMPLE of Turbo Miniaturization Wire. Test it on any electronic application where the continuous operating voltage does not exceed 600 volts R.M.S. See how its thin extruded vinyl primary insulation and thinner extruded nylon jacket resist boiling water, oils, fuels, hydraulic fluids, fungus, abrasion, etc.

TURBO MINIATURIZATION WIRE COMES IN AWG SIZES FROM 30 TO 12 GAUGE . . . in standard or flexible wiring . . . in solid colors, or candy-striped colors with 1, 2 or 3 tracer combinations, to fit your circuit coding needs.

BULLETIN A-4662 gives you more information about TURBO insulation. Ask for it when requesting your samples of TURBO Miniaturization Wire. Write Dept. P-3.



INSULATING MATERIAL TURBO THE BRAND ONLY BRAND MAKES

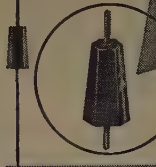
THE WILLIAM BRAND AND CO., INC.

North and Valley Streets, Willimantic, Connecticut — Phone 3-1661

See Us At
Radio
Engineering
Show
Booth 2-113
Grand
Central
Palace
March 23-26

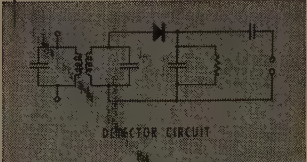
To meet the strictest requirements of both Government and Industry, specify JAN TYPE

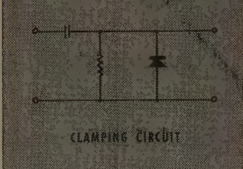
RR Germanium Diodes

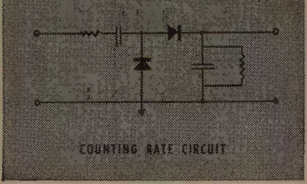


Precision made, easy to handle, easy to assemble—the tapered shape shows polarity at a glance! Make **Radio Receptor** Germanium Diodes your first choice in the large variety of electronic circuits where JAN types are a must.

1N69
1N70
1N81


DETECTOR CIRCUIT


CLAMPING CIRCUIT


COUNTING RATE CIRCUIT

TYPICAL USES

- COMPUTOR CIRCUITS
- CLAMPING CIRCUITS
- RF DETECTORS
- CONTROL CIRCUITS
- DISCRIMINATORS
- MODULATORS
- NOISE ELIMINATORS
- CLIPPERS
- LEVEL SETTERS
- RESTORER CIRCUITS

JAN TYPES • ALL VALUES MEASURED AT 25°C.

CODE NO.	Min. Forward Current at 1 Volt (MA)	Max. Reverse Current (Micro-Amperes)	*Average Rectified Current (MA Max.)	†Minimum Reverse Volts	Max. Cont. Reverse Operating Volts
1N69	5.0	50 @ −10V 850 @ −50V	40	75	60
Rectification efficiency: 35% minimum in 100 MC test circuit.					
1N70	3.0	25 @ −10V 300 @ −50V	30	125	100
1N81	3.0	10 @ −10V	30	50	40

*Average half wave rectified current at 60 CPS and 25°C. Consult us for ratings at other conditions.
†For zero dynamic resistance.

Radio Receptor Germanium Diodes may hold the answer to many of your problems. Our engineers will be glad to study your requirements and submit their recommendations. Many other types, both standard and special, are available . . . Write us!

Seletron and Germanium Division

RADIO RECEPTOR COMPANY, INC.

RR *Since 1922 in Radio and Electronics* RR

SALES DEPT: 251 West 19th Street, New York 11, N. Y. • FACTORY: 84 North 9th Street, Brooklyn 11, N. Y.

IT'S ALLIED FOR RCA

AUTHORIZED
RCA
DISTRIBUTOR

ELECTRON TUBES FOR INDUSTRY

Quick, Expert Service on RCA Tubes

ALLIED maintains in stock for quick shipment, the world's largest distributor inventory of RCA special-purpose tubes. We specialize in supplying the needs of industrial, broadcast, governmental and other users. To save time, effort and money—phone, wire or write to ALLIED. Fill *all* your electronic needs from one complete reliable supply source.

ALL TYPES IN STOCK

- Vacuum Power
- Thyratrons
- Vacuum & Gas Rect.
- Ignitrons
- Cold-Cathode
- Phototubes
- Oscillograph Tubes
- Camera Tubes
- Monoscopes
- Special Types

FREE Interchangeability Directory

Valuable guide to selection of proper RCA tube type replacements. Lists 1600 tube types. Write today for this FREE RCA Guide No. 37-046.

1953 ALLIED CATALOG

Refer to your ALLIED Catalog for all electronic supplies—parts, tubes, test instruments, audio amplifiers, accessories—available from the world's largest stocks. Write today for FREE 1953 ALLIED Catalog.

Everything in Electronics
FROM ONE RELIABLE SOURCE

ALLIED RADIO
833 W. Jackson Blvd., Dept. 35-C-3
Chicago 7, Ill.

FREE CATALOG!—Send for it now!

What to see at the Radio Engineering Show

(Continued from page 209A)

Marconi Instruments Ltd.
New York 4, N.Y.
1-520

FM and AM Signal generators, Q Meters, Admittance bridges, X Band Test Sets, Direct-Reading High Frequency Wavemeters, Vacuum tube voltmeters, and FM Deviation Meters.

Marion Electrical Inst. Co.
Manchester, N.H.
2-303

Marion Multi-Dialer in several ranges; Marion Ruggedized, Hermetically sealed Instruments in accordance with all Government Specifications; Marion regular line of plastic cased, dust sealed instruments; Marion low powered Induction Heating Unit; Marion Model M2 New improved Multi-Ranger Metertester and related products.

McGraw-Hill Publishing Co., Inc.
New York 36, N.Y.
2-301 & 302

Magazines and Books, Electronics and Nucleonics.

LABORATORY STANDARDS

2-327 & 328

MEASUREMENTS CORPORATION
Boonton New Jersey

Measurements Corp., Boonton, N.J. 2-327 & 328
New Standard Signal Generator, Model 84-TV, with frequency range of 300 to 1000 Mc. The instrument has been designed for work in the UHF TV band, and has many other applications in that frequency range. Various other instruments in the company's group of Laboratory Standards.

Melpar, Inc.
Alexandria, Va.
4-816

Miniature and Subminiature S-Band Radar Beacons of both crystal video and superheterodyne types which are suitable for a wide variety of missile and aircraft applications. An electronic correlator capable of plotting auto-correlation or cross-correlation curves on complex functions.

Be sure to visit all four floors!

(Continued on page 211A)

Mepco, Inc.
Morristown, N.J.
2-121

Precision Resistors: All types to MIL-R-93A, JAN-R-93, JAN-R-29 and Commercial—new sealed types.

Metalcraft, Inc., Richmond Hill 18, L.I., N.Y. 4-312
Sheet metal products

Metal Powder Association, New York 17, N.Y. 4-719
New Standards and Specifications for the Iron Powder Electronic Core Producing and Consuming Industries.

Metal Textile Corp.
Roselle, N.J.
4-223

RADIO-NOISE CONTROL DEMONSTRATION with high-level, broad-band noise source—and "Metex." Meets 16E4, JAN-1-225, MIL-I-6181, FCC Regulations, etc. Discuss your Rf leakage problems with our engineers.

Metal Textile Corp., Roselle, N.J. 4-223
Metex electronic weather stripping. Resilient metallic shielding gaskets and strips for controlling Radio-Noise and TVI. Special electronic application of knitted wire shapes, including radar reflectors, tube grids, washers, etc.

Mica Fabricators Association, New York N.Y. 3-517
Mica parts and components using mica.

Microtran Company, Far Rockaway 91, N.Y. 4-128
SALES AFFILIATE OF CREST LABORATORIES, INC. Transformers; Reactors; Coils; Hermetically sealed and open frame Miniature, Sub-Miniature, and sub-sub Miniature Transformers; specialized transistor transformers; Hi-Q Audio Components; Line Voltage adjusters; Cathode Ray Tube Rejuvenator Transformers.

Micro Div. of Minneapolis-Honeywell Reg. Co., 101 Park Ave., New York 17, N.Y. 2-122
Makers of precision switches. Manual control switches: AN & JAN toggles, subminiature toggles, multipole toggles, hermetically sealed toggles. Sealed pushbuttons, multipole subminiature pushbuttons. Interlocks: Small multipole cheatable many variations. Precision snap-acting switches: cam operated, enclosed, hermetically sealed, subminiature, double pole, magnetic blowout, and special assemblies.

Microwave Associates, Inc., Boston 15, Mass. 4-218
New improved Silicon diodes for radar and Microwave relay mixer use featuring low noise and constant RF and IF characteristics. Radar magnetrons, TR and ATR tubes for S, X, and millimeter bands. Waveguide components and test equipment for millimeter and centimeter wave lengths.

Microwave Development Labs., Inc., Waltham 54, Mass. 4-601
Waveguide Components including Side and Top-wall hybrids, balanced mixers, balanced duplexers, temperature compensated tunable cavities, E and H bends, high power rotary joint and custom built directional couplers.

WORLD'S LARGEST
Manufacturer of Quartz Crystals
for Electronic Frequency Control
whatever your crystal need . . .
conventional or highly specialized . . .
when it has to be EXACTLY RIGHT . . .
4-613
Call on MIDLAND MFG. CO.
3155 Fiberglas Road Kansas City, Kans.

(Continued on page 212A)

what's new at EBY?

- new components for UHF application
- new sockets
- new rack and panel connectors
- new printed circuits
- new crossover network
- and many other components

see the entire
EBY LINE
BOOTH 2-101
RADIO ENGINEERS SHOW

HUGH H. *EBY* INC.

4702 Stenton Avenue
Philadelphia 44, Pa.

DEPEND ON "INDUSTRIAL" .... for ELECTRONIC COMPONENTS

Precision-engineered Electronic Components and connecting devices for all your needs.

RADIO-ELECTRONICS
A Preview of Progress
I.R.E. CONVENTION
RADIO ENGINEERING SHOW

VISIT WITH US AT BOOTH
2-101

WALDORF-ASTORIA HOTEL
GRAND CENTRAL PALACE
NEW YORK CITY
MARCH 23-26 1953

- LAMINATED TUBE SOCKETS
- TERMINAL STRIPS
- WIRED ASSEMBLIES
- METAL or BAKELITE STAMPINGS
- TERMINAL BOARD ASSEMBLIES
- SCREW MACHINE PARTS

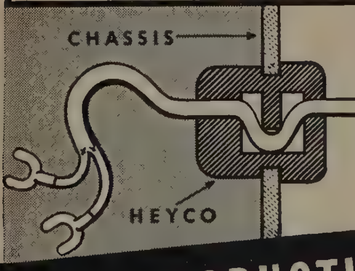
——NEW ITEMS——

- TUNER STRIPS, SOCKETS and BRACKETS for UHF

Our extensive design and production facilities are available for developing your special requirements and applications. Representatives in principal cities throughout U.S.A. Call or write for samples and information.

INDUSTRIAL HARDWARE MFG. CO., INC.
109 PRINCE ST., N.Y. 12. Phone: OR 7-1881

Facts you should know about HEYCO STRAIN RELIEFS!
the Nylon Bushings that Anchor cord to housing



1. Absorb cord pull, push and torque

2. Insulate wire from housing

CUT PRODUCTION COSTS
IMPROVE PRODUCT QUALITY

APPROVED CSA UL

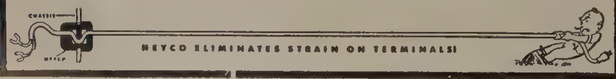
THE HEYMAN ORGANIZATION WITH 25 YEARS STAMPING EXPERIENCE HAS MODERN PRESS CAPACITY FOR OVER 2,000,000 FINISHED STAMPINGS PER DAY.

ASK FOR BULLETIN 33

HEYCO

SAMPLES? Send wire size and chassis information—
Try HEYCOS at no cost to you—today!
MADE IN ALL SIZES FOR CLOCK WIRE TO S-10/3 CABLE

HEYMAN MANUFACTURING COMPANY
KENILWORTH 7 NEW JERSEY


CHASSIS
HEYCO ELIMINATES STRAIN ON TERMINALS!

What to see at the Radio Engineering Show

(Continued from page 211A)

Midland Manufacturing Co., Inc., Kansas City, Kan. 4-613
Exhibiting some of the standard Quartz Crystal Types available in production quantities and a new type unit in the audio frequency range. There will also be demonstrations of the basic phenomena of Piezoelectricity. Midland's representatives will be present to discuss crystal problems and applications.

Midwestern Geophysical Laboratory, Tulsa, Okla. 4-403
Hydraulic Servo Components, Recording Oscillographs, Galvanometers

James Millen Mfg. Co., Inc.
Malden 48, Mass.
1-507
Delay Lines—Grid Dip Meters, Radar, Radio & Electronic Equipment & Components. Magnetic Metal Shields.

Millivac Instrument Corp.
Schenectady 6, N.Y.
4-112
Manufacturers of extra-sensitive DC and AC vacuum tube voltmeters, capable of measuring 1 microvolt DC at 1,000 ohms input impedance, 100 microvolts DC at 6 megohms, also 100 microvolts AC up to 6 megacycles and millivolt above 1 megacycle.

Milwaukee Transformer Co., Milwaukee 9, Wis. 4-807
Transformers and allied products

Minneapolis-Honeywell Reg. Co., Aeronautical Div., Freeport, Ill. 2-122
The display will feature a complete line of automatic controls for aircraft including operating demonstrations of rate gyros, vertical and cageable vertical gyros, and Hermetic Integrating gyros. Also demonstration of altitude control and display of various actuators and amplifiers.

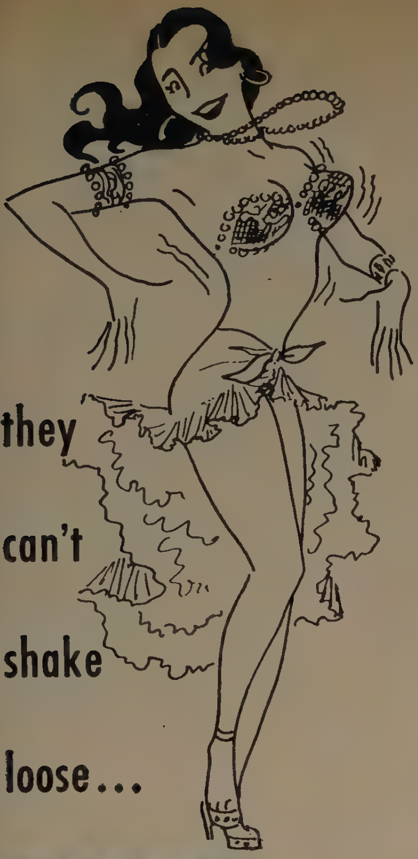
Model Engineering & Mfg. Inc.
Tru-Ohm Products Division
Chicago 18, Illinois
4-119
Resistors: Rheostats, Wirewound, variable. Wirewound, fixed, Wirewound, precision.

Muirhead & Co., Ltd., Beckenham, Kent, Eng. 4-804
D-489 Muirhead-Pametrada Wave Analyser. This analyser breaks away completely from the conventional heterodyne principle and employs two R.C. tuned selective amplifiers in cascade. Though intended primarily for vibration measurements the instrument can also be used for general waveform analysis. Features: Range 19 cps-21 Kc; frequency accuracy ±0.5% over most of range. Selectivity and band-width variable; maximum 2nd harmonic suppression 70 db over whole range. Power supply: 91-120 V; 60 cps; 130 W.

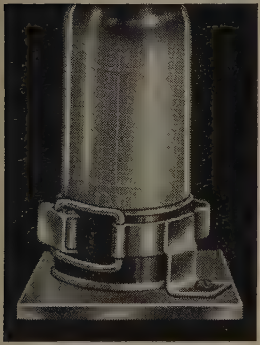
Multi-Metal Wire Cloth Co., Inc., New York 59, N.Y. 4-314-316
Cathode-Ray Tube Shields, Cabinets, Chassis, Dust Covers, Panels, Racks, Shields.

Muter Co., Chicago 5, Ill. 3-506 & 507
Ceramic capacitors, wire wound resistors, rf and IF coils, precision potentiometers, switches.

(Continued on page 214A)



they can't shake loose...



HOLD THEM TIGHT with a

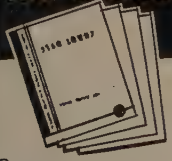
BIRTCHER CLAMP

There is a Birtcher Clamp ... *or one can be designed* ... for every tube you use or intend to use.

Regardless of the type tube or plug-in component your operation requires ... and regardless of the vibration and impact to which it will be subjected ... a Birtcher Tube Clamp will hold it securely and *rigidly* in place.

Catalog and samples sent by return mail.

The BIRTCHER CORPORATION
4371 Valley Blvd.
Los Angeles 32, Calif.



Please send catalog and samples by *return mail.*

Company ______________ IRE 3-3
Attention of: ______________
Address ______________
City ______________ State ______________

SUB-MINIATURE
PILOT LIGHTS
Approved for AIRCRAFT
AND IMPROVED IN IMPORTANT DETAILS

DIALCO

SUB-MINIATURE INDICATOR ASSEMBLIES

A great aid to your miniaturization program

NON-DIMMING
No. 8-1930-621

MOUNT IN 15/32" HOLE
ALL LENS COLORS

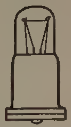
Easy lamp replacement with any midget flanged base lamp types

Complete blackout or semi-blackout dimmer types

MECHANICAL DIMMER
No. 11-1930-621

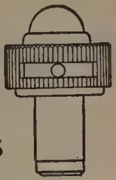
THESE ASSEMBLIES LOGICALLY REPLACE LAMPS NO. 319, 320, and 321

REPLACE WITH THIS



NOT THIS

OR THIS



PLASTIC PLATE (EDGE) LIGHT ASSEMBLIES

AIR FORCE and BUREAU of AERONAUTICS
MIL-L-7806 DRAWING MS-25010

DIALCO *No. TT-51* (Red filter-black top)
. . . or, *No. TT-51A*, complete with No. 327 Lamp

ALSO MADE
with other filter colors
and with *light-emitting top* (for indication)

ALL OF THE ASSEMBLIES ILLUSTRATED ACCOMMODATE LAMPS NOS. 327, 328, 330, and 331.

ANY ASSEMBLY AVAILABLE COMPLETE WITH LAMP

SAMPLES ON REQUEST — NO CHARGE

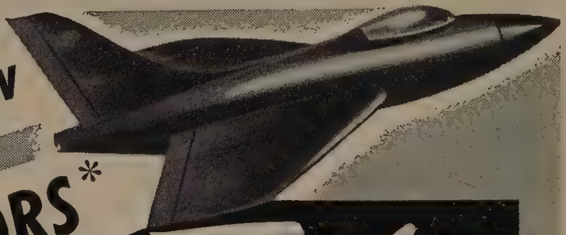
Foremost Manufacturer of Pilot Lights
DIALIGHT CORPORATION
60 STEWART AVENUE, BROOKLYN 37, N. Y. HYACINTH 7-7600

© 1952

Visit us in Booth #1-504 at the IRE Show.

☆ SEE ☆
the NEW DEVELOPMENTS
in ★ coil winding ★
equipment ☆
AT THE
1953 IRE SHOW
MARCH 23-26
BOOTH 3-521

Coil Winding Equipment Co.
109 AUDREY AVE., OYSTER BAY, NEW YORK



TEFLON now IN 14 COLORS*

Featuring

Tensolon
HI-TEMP
HOOK-UP WIRE

- EXTRA FLEXIBILITY
- FREE STRIPPING
- HIGH DIELECTRIC
- RATING -90 TO +250°C

*Black, brown, red, orange, yellow, green, blue, violet (purple), grey (slate), white, tan, pink (flesh), light green, light blue.

Built to meet rigid government requirements, Tensolon Hook-up Wires are available in sizes from AWG30 through 20 with stranded silver-plated copper conductors and the patented **Tensulated** Teflon® covering which eliminates pin holes and other irregularities.

TEFLON KIT FOR LABORATORY REQUIREMENTS—
Twelve 100 ft. rolls of AWG 22, in assorted colors in convenient compact container $124.00

AT THE I.R.E. SHOW-BOOTH 4-124

TENSOLITE INSULATED WIRE CO., INC., TARRYTOWN, N. Y.

What to see at the Radio Engineering Show

(Continued from page 212A)

MYCALEX
CORPORATION OF AMERICA
Clifton, N.J.
30 Rockefeller Plaza, New York 20, N.Y.
BOOTHS 1-130 & 131

Owners of MYCALEX Patents and Trade-Marks. Mycalex glass bonded mica the ideal insulation for all frequencies and temperatures.

Mycalex Corp. of America, Clifton, N.J. 1-130 & 131
Mycalex glass-bonded mica Ceramoplastic: insulation takes 2000° F for very brief periods; telemetering commutator; coil form for coded radio; air circuit break arc chute; molded-with-fragile-inserts switch for correcting gyro compensation; radio frequency switch; minimum differential expansion spur gear, functional part with solderable molded-in inserts and printed circuit.

N. R. K. Mfg. &
Engineering Co.
Chicago 41, Ill.
2-212

Microwave components such as Antenna Feeds, Rotary joints, Duplexer-Mixer An'yn., Crystal Mixers, Directional Couplers, Waveguide Switches, manufactured to your blueprints and specifications.

LINDE AIR PRODUCTS CO.
Div. Union Carbide and Carbon Corp.
Booth I-514
NATIONAL CARBON CO.
Div. Union Carbide and Carbon Corp.
Booths I-516 & I-518
UNION CARBIDE AND CARBON CORP.
Booths I-514, I-516 & I-518
SEE: LINDE AIR & NATIONAL CARBON
Thank you for your co-operation.

National Carbon Co., Div. of Union Carbide & Carbon Corp., New York 17, N.Y. 1-514-516 & 518
Outstanding examples of famous "Eveready" battery line, grouped in six separate categories: Personal Radio, Portable Radio, Home Radio, Radiation Detectors, Heating Aid, and Photoflash. New Batteries on display will be the compact No. 964-477 "Personal" Radio Battery Complement, round-cell photoflash types and the tiny No. 1002E Hearing Aid "A" Battery.

National Co., Inc., Malden 48, Mass. 2-105
The latest in Government, Commercial, Amateur Communication Equipment, and Components. A new communication receiver in the low price field will be shown for the first time and several new electronic components.

National Research Corp., Vacuum Engineering Div., Cambridge 42, Mass. 1-705
Pumping dolly for in-line exhaust system; new, improved, and more compact diffusion pumps; new Model 511 "Alphatron" vacuum gauge.

New Hermes Engraving Machine Corp., New York 3, N.Y. 2-131 & 132
New Hermes pantograph engraving machines in action, for engraving name plates, panels, dials, profiling, milling on all metals and plastics.

Be sure to visit all four floors!

(Continued on page 216A)

These **3** *insulating materials now available in the*

BIGGEST SINGLE SHEETS *ever made*

King-sized TEFLON sheets, *60" x 72"*, prevent leakage and blow-through on large gaskets. Ideal for many uses.

•

5 foot KEL-F discs open vast new potentialities for this versatile thermoplastic. New size increases economy, eliminates waste.

•

It's no secret that the A. E. C. chose *4 foot* MYKROY rings to insulate its generator. There's a growing demand for this perfected glass bonded mica.

•

Sheets, rods — machined or molded to specification. Write today for our new TEFLON, KEL-F and MYKROY brochures.

ELECTRONIC MECHANICS INC.

101 CLIFTON BOULEVARD,
CLIFTON, NEW JERSEY
MYKROY, INC., WHEELING, ILL.

See us at Booth #4-610, Radio Engineering Show

Sensitive DC-VTVM Furthers Electronic Research and Production

Progress in electronic engineering, as in other fields of engineering, is closely linked with the development of more sensitive measuring instruments. During the past 4 years our MV-17B DC Vacuum Tube Millivoltmeter has helped substantially to advance both research and production throughout the entire electronic field. Crystal diodes and transistors for instance have benefited from it due to its ability to measure small DC voltages with minimum circuit loading (1 mV full scale, 6 megohms input impedance). As a null detector, in bridges, the MV-17B can be overloaded up to 100,000 times, thereby eliminating suspension-galvanometer trouble and increasing measuring ranges and sensitivity. Grid current measurements, small voltage drops in regulated power supplies, delicate temperature measurements, insulation material research are but a few other applications which have made this instrument a reliable stand-by in nearly all leading laboratories in America and abroad.

MV-17B DC-Millivoltmeter

•

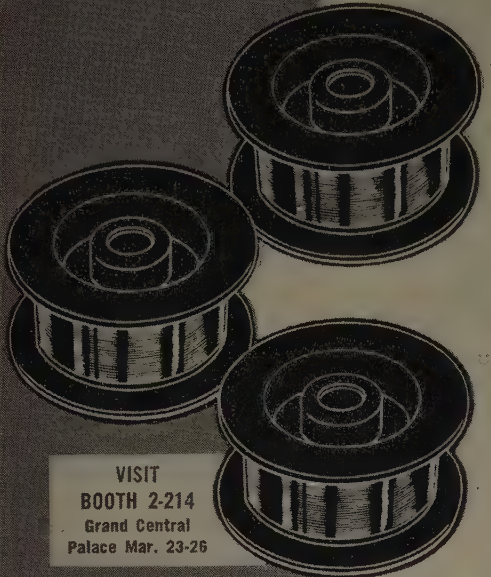
"It Measures Where Others Fail"

Other Millivac Meters, Similar to MV-17B.

- MV-17BX DC Millivolt meter, identical with MV-17B but equipped with external output terminals. Used as high-gain DC amplifier or to operate external indicating and recording instruments.
- MR-67B DC Millivolt Recorder, sensitivity 200 microvolts per centimeter. Uses Sanborn heat-writing unit.
- MV-18B High Frequency Voltmeter. Has MV-17B DC measuring circuit and external crystal probes. Covers 1 MC to 2,500 MC, lowest reading 1 mV. Measures also 100 microvolts to 10 mV DC.

MILLIVAC INSTRUMENT CORPORATION
P.O. BOX 997, Schenectady, N.Y.

Fine Wire
FOR
TRANSISTORS



In line with our specialization in wire for new applications, we produce wires of composition suitable for the manufacture of Transistors; including GALLIUM GOLD and ANTIMONY GOLD. These alloys have been made to fill a specific need arising from new developments in this field.

Other wires we make regularly for similar application are PHOSPHOR BRONZE, bare or electroplated, and PLATINUM Alloys produced to meet rigid specifications of tensile strength, size and straightness.

VISIT
BOOTH 2-214
Grand Central
Palace Mar. 23-26

Write for Latest List of Products

SINCE 1901

SIGMUND COHN CORP. 121 So Columbus Avenue • Mount Vernon, N.Y.

IT'S
HARVEY
FOR PROMPT
"OFF-THE-SHELF" DELIVERY

Whether it's equipment, components or other electronic requirements, you will always find them in Harvey's extensive stocks, ready for immediate delivery to you anywhere.

This month particularly, Harvey has looked ahead and is ready to supply any of products exhibited at the . . . I.R.E. SHOW.

WRITE
PHONE
or WIRE

hrc

HARVEY
RADIO COMPANY, INC.
103 West 43rd St., New York 36, N. Y.

Telephone
LUxemberg 2-1500

What to see at the Radio Engineering Show

(Continued from page 214A)

The J. M. Ney Co.
Hartford 1, Conn.
4-101

Precious metal alloys and their uses in precision electronic instruments. Contacts, slip rings and assemblies to customer specifications. Fine size resistance wire in precious metal alloys.

North Electric Mfg. Co., Galion, Ohio 4-517
The North Electric Manufacturing Co. has had 50 years' experience in the manufacture of relays. We manufacture relays designed for military aircraft, for computers, remote and studio, and calculating machines, also relays for general communication equipment.

Northern Radio Co., Inc., New York 11, N.Y. Theater 3-210
Communications Equipment

Nuclear Instrument & Chemical Corp., Chicago 10, Ill. 4-123
Complete line of electronic instrumentation for detecting and measuring nuclear energies. Several new sealing instruments will be shown, as well as portable survey meters and accessories. Nuclear's new revolutionary automatic sample changer will also be on exhibit.

Oak Mfg. Co., Chicago 10, Ill. 4-606
Rotary, pushbutton and slide switches; television converters and tuners; choppers, vibrators and power supplies; Ledex rotary solenoids and other special electromechanical assemblies. Development and production for manufacturers only.

Be Right with
OHMITE

RHEOSTATS • RESISTORS
TAP SWITCHES
R.F. CHOKES
BOOTH 2-213

Optical Film Engineering Co.
Philadelphia 33, Pa.
4-216

A complete line from 1" to 10" of our superior Multijet Oil Diffusion Pumps. The "Vapor Frac" fractionating pump group using the new vapor separation principle. The SC-3 high vacuum evaporator designed for research on evaporated coating. Evaporated films of metals and dielectrics for electrical and optical purposes.

John Oster Mfg. Co., Racine, Wisconsin 4-815
Fractional horsepower motors synchros, servo motors, and actuators.

PSC Applied Research Limited
Toronto 13, Canada
4-122

Airborne Magnetometer, Airborne Profile Recorder, Photogrammetric Instruments, Intervalemeters, Cameras, Recording Time Interval Measuring Sets, Navigational Computers, Airborne Radiation Detector.

(Continued on page 218A)

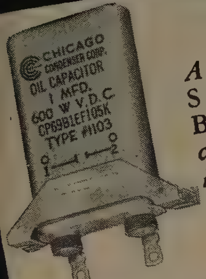
OIL IMPREGNATED

CHICAGO

APPROVED

VACUUM FILLED

CAPACITORS



Approved SILICONE BUSHING capacitor, oil impregnated, hermetically sealed.

Featuring SILICONE BUSHINGS for peak performance at high temperature operation.

SILICONE BUSHING BATHTUB TYPE capacitor, oil impregnated, hermetically sealed, and tested at twice rated voltage to meet all specifications.

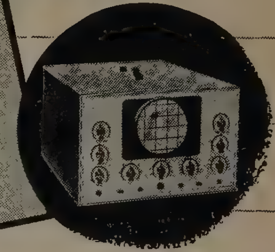
GLASS SEALED TUBULAR TYPE capacitor, oil impregnated, hermetically sealed to meet all specifications.

WRITE US FOR FURTHER INFORMATION.

CHICAGO
CONDENSER
CORPORATION
3255 WEST ARMITAGE AVE.
CHICAGO 47, ILLINOIS

how Can it be made

If your problem requires 1 Close tolerance 2 High interior surface finish 3 Intricate design



It can be LECTROFORMED!*

If the radio frequency component you need cannot be made by conventional methods or is difficult and costly to manufacture, the possibilities are it can be *LECTROFORMED.*

Write Dept. IRE-53 for "Lectroforming Applications and Procedure"

* Trademark

LECTROFORMING can produce parts of intricate design, accurate interior dimensions and with high interior surface finish up to 5 micro-inch. Various metals may be used (such as silver, gold, copper, nickel and/or iron) to meet specific requirements for conductivity, strength and corrosion resistance.

LECTROFORMING achieves dimensional stability impossible by any other method.

LECTROFORMING is the manufacturing of an article by the electrode position of metal on a form of predetermined size, shape and finish. We welcome the opportunity to discuss your problem, no matter how difficult it may seem.

Visit our Booth 3-525 at IRE Show

BART

BART LABORATORIES CO., INC.
227 Main Street, Belleville 9, New Jersey

DX Announces
a NEW 90° YOKE for 27" TUBES

It's Engineered for
TOP PERFORMANCE
... in Production NOW!

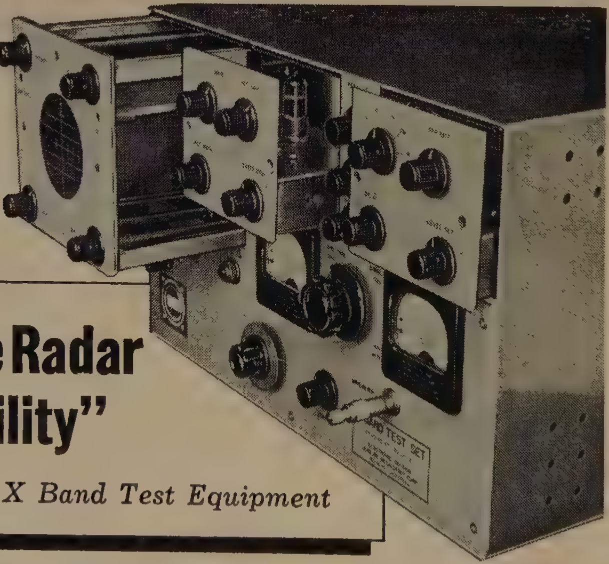
This new DX 90° Deflection Yoke has everything a television receiver manufacturer wants . . . a sharp full-screen focus, a minimum of pincushioning, the ultimate in compactness and a price that's downright attractive. Because this yoke has been brilliantly designed for mass production on DX's specialized equipment, it warrants immediate consideration in your 27" receiver plans. Write us today.

DEFLECTION YOKES . . . TOROID COILS . . . CRYSTALS
I. F. TRANSFORMERS . . . R. F. COILS . . . DISCRIMINATORS
SPEAKERS . . . TV TUNERS . . . ION TRAPS . . . TRANSFORMERS

DX COMPONENTS
"the heart of a good television receiver"
TRADE MARK

DX RADIO PRODUCTS CO.
GENERAL OFFICES: 2300 W. ARMITAGE AVE., CHICAGO 47, ILL.

Model 109



"Complete Radar Test Facility"
Multi-Purpose X Band Test Equipment

Spectrum Analyzer { Displays supplied spectra from 8.5 to 10. KMC on a 3" CRT
Signal Generator { Delivers CW, square wave, FM, or pulse (1, 5 or 10 μs) modulated RF, 8.5 to 10 KMC up to 25 MW
Power Monitor { Measures average power of CW or pulsed RF, external or internal, from 8.5 – 10.5 KMC
Frequency Meter { Measures applied RF from 8.5 – 10.5 KMC to .1% accuracy.

All major units plug in, 17" x 10½" x 13". 45 lbs.

ELECTRONIC DIVISION
Century Metalcraft Corporation
BOX 2098—14806 OXNARD STREET
VAN NUYS, CALIFORNIA

What to see at the Radio Engineering Show

(Continued from page 216A)

Panelyte Division, St. Regis Paper Co., New York 17, N.Y. 4-619 & 621
Laminated resinous plastics—sheets, rods, tubes, fabricated parts, molded specialties in paper, fabric, glass, nylon base; with phenolic, melamine and silicone resins. Injection molded parts. Decorative Panelyte. Featured parts for the television, radio and electronics industries. High strength, high heat resisting laminates. Metal clad laminates for printed circuits.

Panoramic Radio Products, Inc.
Mount Vernon, N.Y.
2-123

Spectrum analyzers covering the audio to Microwaves, and Response Curve Indicators dynamically demonstrated. New instruments include Panalyzor, Model SB-12, a slow sweep, high resolution, RF Spectrum Analyzer; Model G-3; Ultrasonic Response Indicator covering range between 2 KC and 300 KC and a Signal Switcher for Panoramic Sonic Analyzers, Models AP-1 and LP-1.

Paramount Paper Tube Corp.
Fort Wayne 2, Ind.
4-705

If you wind coils or transformers of any size, get a free sample of the "Paraformed" square and rectangular paper tubes made by Paramount Paper Tube Corp.—Mfgrs. of coil cores exclusively for more than 20 years.

Par-Metal Products Corp.
Long Island City 3, N.Y.
2-119

Metal Products for Electronic Industry.

Penta Laboratories, Inc.
Santa Barbara, Calif.
4-710

Displaying their new line of medium and high-power Power Tetrodes incorporating a high efficiency anode of unique design. Also on display will be other power tubes, Hydrogen Thyratron, Vacuum Switch and special purpose tubes of their manufacture.

Phalo Plastics Corp., Worcester 8, Mass. 4-508
Thermoplastic insulated wire and cable, cord sets, and harness assemblies.

Philco Corp., Government and Industrial Div., Philadelphia 44, Pa. 1-501, 505
Microwave communications and television relay equipment, including associated time and frequency division multiplexing equipment, antennas and towers. Also tube exhibits displaying research, development and production of receiving, cathode-ray and special-type tubes for government & industry.

Be sure to visit all four floors!

(Continued on page 220A)

New 800-2600 MCS Frequency Meters

Lightweight-Portable Units.. For Field and Laboratory Use!

Models
FS-C-171-A 800-1200 MCS.
FS-C-172-A 1200-1600 MCS.
FS-C-173-A 1600-2250 MCS.
FS-C-174-A 1700-2600 MCS.

The input circuit is a type N connector (UG-58/U) . . . The output is monitored by a IN21B crystal and microammeter circuit with adjustable sensitivity control for varying input power levels. The output of the crystal may be obtained from pin jacks provided on the panel of the instrument. A switch is provided to change the output from the microammeter to the pin jacks.

SPECIFICATIONS

ACCURACY
Better than .05% from 20°F to 120°F

SENSITIVITY
Usable indication with 1 milliwatt input
Adjustable for higher levels

INDICATOR 50 Microammeter

INPUT
50 Ohm Type N Connector

EXTERNAL DC OUTPUT
Pin Jacks

EXCURSION OF MICROMETER
One-half inch

MICROMETER SCALE
at 1000 Mc — 1 Division equals 290 KC
at 1400 Mc — 1 Division equals 350 KC
at 2000 Mc — 1 Division equals 450 KC
at 2600 Mc — 1 Division equals 555 KC

EXTERNAL SIZE 6½ x 9¾ x 7"

WEIGHT Four pounds

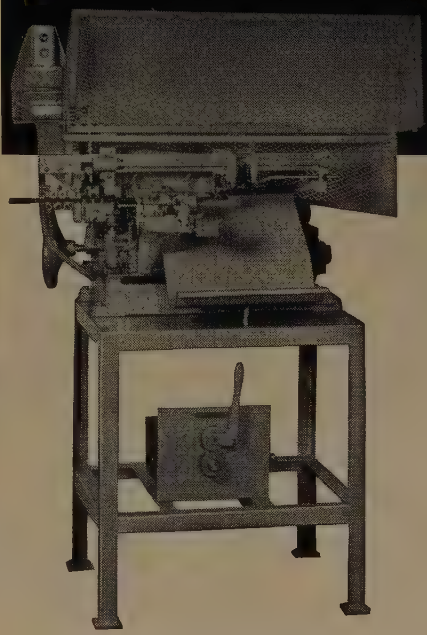
CAVITY UNITS AVAILABLE

Units consist of cavity body, micrometer control, crystal, suitable connectors and calibration chart. Write for specifications and prices.

frequency standards

P. O. Box 504,
Asbury Park, New Jersey

How to CUT AND STRIP INSULATED WIRE... as fast as 3000 lengths per hour



MODEL CS-6E CAPACITY

Finished Pieces Per Hour—15 in. lengths, 3000 per hour; 97 in. lengths, 500 per hour.

Maximum Stripping Length—1½ in. at each end.

Maximum Cutting Length—97 in.

Minimum Cutting Length—2 in. (⅞ in. special).

Wire Handled—Solid or stranded single conductor wires, parallel cord, heater cord, service cord, etc.

Maximum Wire Size—No. 10 stranded or No. 12 solid.

Other Artos Machines

The complete line of Artos automatic wire cutting and stripping machines will handle *cut lengths* from 1 in. to 60 ft., *stripped lengths* to 6½ in. at one end and 8½ in. at the other, *wire* from No. 12 to No. 000 gauge, and up to 3600 pieces per hour. Ask for recommendations on your own specific problems.

ARTOS Automatic MACHINES REDUCE TIME AND COST

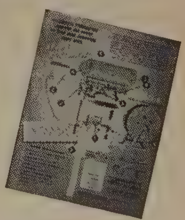
For quantity production of finished wire leads . . . measured, cut to length, and stripped at one or both ends . . . investigate Artos Automatic Machines.

The Model CS-6 illustrated can complete up to 3,000 pieces per hour in 15-in. lengths, and other lengths in proportion. You save through combined operations . . . through quick, easy set-up . . . through unskilled help who can handle this machine. You obtain substantial time savings over the best manual or semi-automatic methods.

Highly accurate machine operation reduces work spoilage to an absolute minimum — errors due to the human element are eliminated. There is no cutting of strands or nicking of solid wire. Uniform lengths and uniform stripping are produced consistently.

WRITE FOR BULLETIN

Get the complete story—write now for Bulletin 35-C on Artos Model CS-6 machines.



Automatic Wire Cutting and Stripping

ARTOS ENGINEERING CO.

2735 S. 28th St. • Milwaukee 46, Wis.

High Speed
Multi-Channel
Sampling Switches

For pulse telemetering, sub-carrier commutation, drift compensation of DC amplifiers, function generation and miscellaneous samplings measurements.

Specialists in the design and manufacture of rotary switches, with and without motor drive, for difficult and demanding applications.

ASCOP
WE PROVIDE THE LEVER YOU MOVE THE WORLD

Your Inquiries Are Invited
Write or telephone Mr. Porter
PLainsboro 3-4141

APPLIED SCIENCE CORPORATION OF PRINCETON
Telemetering and Data Handling Equipment and Special Components
P. O. Box 44, Princeton, New Jersey
See Us at Booth 4-806, Radio Engineering Show, March 23-26

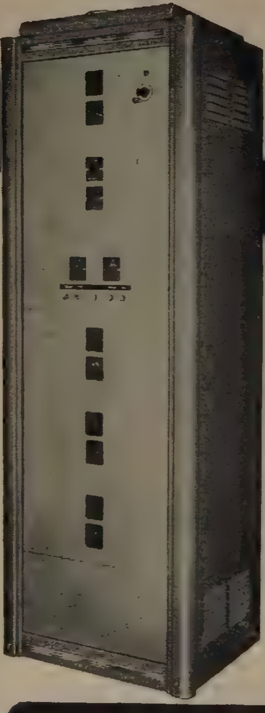
THE DISTINCTIVE NEW
ER-225
SERIES
RACKS by PAR-METAL
18″ Deep, 22″ Wide

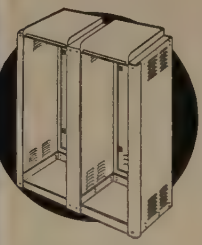
offer you the greatest dollar-for-dollar value in the industry today!

Because only in the ER-225 will you find these unique features:

- *Standard 43¼″, 67¾″, and 83½″ heights.*
- *New ribbed design corner trims, with new quick FRONT detachable fastenings.*
- *The door is stamped from one piece of steel and reinforced—with formed, clean, smooth, double thick edges.*
- *"Multiracks" available with closed or open intermediate sides for rack-to-rack wiring.*
- *Streamlined modern design; beautiful finish.*

Planning an electronic product? Consult Par-Metal for
RACKS • CABINETS
CHASSIS • PANELS
Remember, Par-Metal equipment is made by electronic specialists, not just a sheet metal shop.





"MULTIRACKS"
These Racks may be assembled in multiple units as shown above.
SHELVES available.
Also ROLLER TRUCKS available for single racks or "Multiracks".

NO INCREASE IN COST!
The *ER-225* is priced to compete with racks not having the equivalent features. Beyond doubt—*it's the industry's greatest value.*

The ER-225 Rack as used by the American Communications Corp., N. Y. C. 13.

Made by Electronic Specialists!

PAR-METAL
PRODUCTS CORPORATION
32-62 — 49th ST., LONG ISLAND CITY 3, N. Y.
Tel.: AStoria 8-8905
Export Dept.: Rocke International Corp.
13 East 40 Street, New York 16, N. Y.

WRITE FOR CATALOG!

Visit us in Booth #2-119 at the IRE Show

(Continued from page 218A)

Phillips Control Corp., Joliet, Ill. 4-702
A complete line of relays, hermetically sealed relays, and actuators. We will feature our new Type 6 relay, first introduced in the publications this month. We will also show our new Electronic Timer, which will time our relays and operate lights in our display.

Photo Chemical Products, Ind., New York 51, N.Y. 3-308
Screen printing. Metal furnishing and spraying of industrial panels, instrument dials and schematics. Radium luminescent applications.

photocircuits CORPORATION
GLEN COVE
NEW YORK
BOOTH 4-102 "Photocircuits PRINTED CIRCUITS" and allied electronic assemblies are exhibited. FEATURED: Radio chassis, Filters, Terminal boards, Miniaturized packages, Plug-in computer-units and long-wearing Wiping Switches and Commutators. Cost comparisons: Dip soldered printed circuit vs. conventionally wired assemblies. FREE Engineering Brochure.

The Pioneer Elec. & Research Corp., Forest Park, Ill. 3-519
SRX-Electro-Mechanical Remote Switching systems; ERX—Electronic Remote Switching systems; Electrowriter—Permanent Magnet Motors and Generators; Electronic Keyer.

Plastoid Corp.
Long Island City 1, N.Y.
4-305

Replica of a Community TV antenna installation, samples of "Synkote" wire and cable constructions for HF, VHF and UHF transmission, unusual cables designed for specific installations, tubular and heavy-duty twin-lead for television receivers.

Polarad Electronics Corp.
Brooklyn 11, N.Y.
2-511

Microwave Test Equipment. Its Model LSA, All Band direct reading Spectrum Analyzer, Microwave Receivers, and Microwave Signal Sources can be seen. Also Polarad's advanced TV Monitor and Waveform Monitors can be seen.

The Polymer Corp. of Pa.
Reading, Pa.
3-503

POLYPENCO NYLON and TEFLON available for economical fabrication in rod, tubing, strip, slab and special extruded shapes to specification. Also available to your specifications in machined and molded parts.

Polytechnic Research & Dev. Co., Inc.
Brooklyn 1, N.Y.
2-513 & 514

Standard Microwave Test Equipment, Ridged Waveguide Components, Flat Guide Components, Noise Source, VHF-UHF Sweep Generator, Metallized Glass Products.

(Continued on page 222A)

Accurate • Portable • AVAILABLE

the Type H-12 UHF SIGNAL GENERATOR

900-2100 Megacycles

This compact, self-contained unit, weighing only 43 lbs., provides an accurate source of CW or pulse amplitude-modulated RF. A well-established design, the Type 12 has been in production since 1948. The power level is 0 to —120 dbm, continuously adjustable by a directly calibrated control accurate to ± 2 dbm. The frequency range is controlled by a single dial directly calibrated to ± 1%. Pulse modulation is provided by a self-contained pulse generator with controls for width, delay, and rate; or by synchronization with an external sine wave or pulse generator; or by direct amplification of externally supplied pulses.

Gold Plating of the oscillator cavity and tuning plunger assures smooth action and reliable performance over long periods. Generous use of silicone-treated ceramic insulation, including resistor and capacitor terminal boards, and the use of sealed capacitors, transformers, and chokes, insures operation under conditions of high humidity for long periods.

Built to Navy specifications for research and production testing, the unit is equal to military TS-419/U. It is in production and available for delivery.

Price: $1,950 net, f.o.b. Boonton, N. J.

Type H-14 Signal Generator

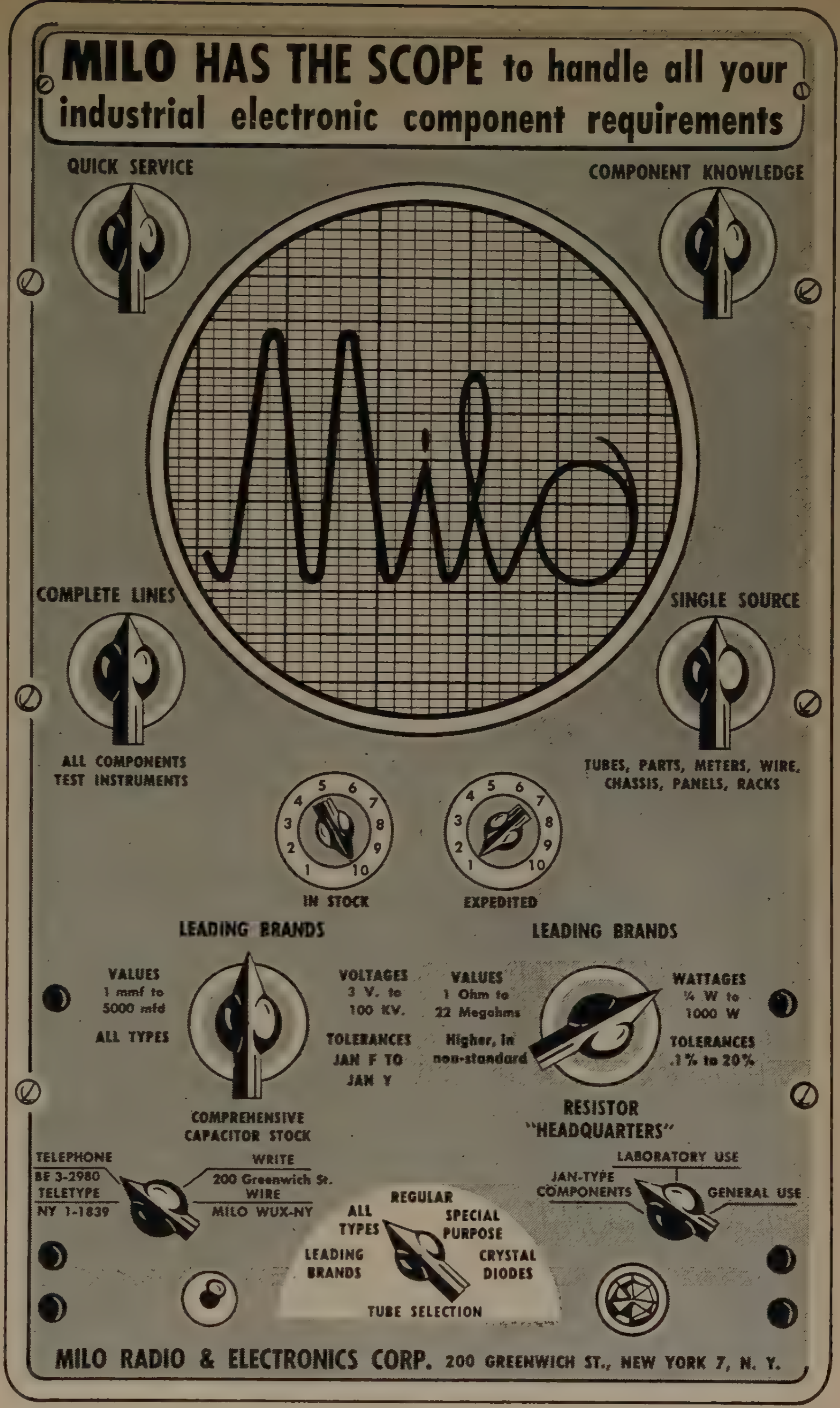
(108 to 132 megacycles) for testing OMNI receivers on bench or ramp. Checks on: 24 OMNI courses, left-center-right on 90/150 cps localizer, left-center-right on phase localizer, Omni course sensitivity, operation of TO-FROM meter, operation of flag alarms.

Price: $942.00 net, f.o.b. Boonton, N. J.

WRITE TODAY for descriptive literature on A.R.C. Signal Generators or airborne LF and VHF communication and navigation equipments, CAA Type Certificated for transport or private use. Dept. 6

Dependable Electronic Equipment Since 1928

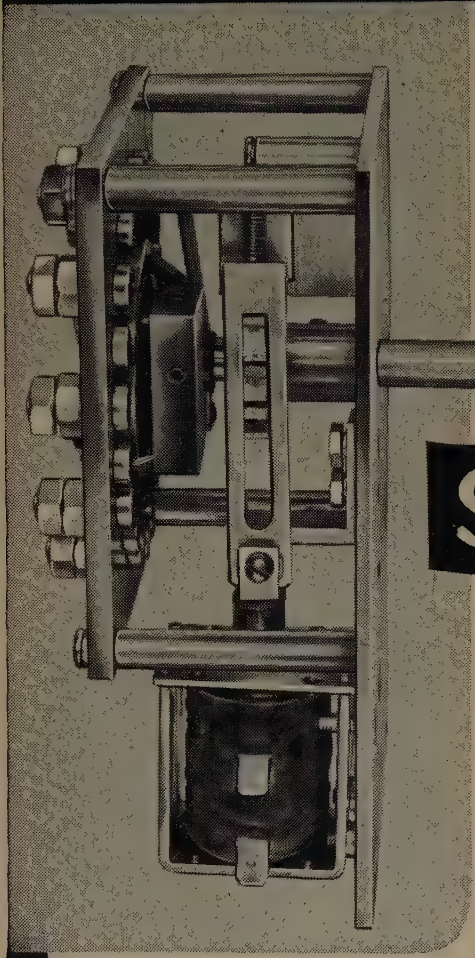
Aircraft Radio Corporation
Boonton, New Jersey



MILO tenders its heartiest congratulations to The Institute of Radio Engineers on the occasion of its Twenty-First Annual Show. We expect to see many new things there.

For "something new" in 'scopes, see above.

MILO RADIO & ELECTRONICS CORP.
Electronics for Industry
200 GREENWICH STREET, NEW YORK 7, N.Y. • Phone BEekman 3-2980
Teletype NY1-1839 • Wire MILO-WUX-N.Y. • Cable MILOLECTRO-N Y.



Ruggedly Designed for Dependable, Heavy-Duty Operation

TECH LABS SOLENOID OPERATED SWITCHES

When operating conditions demand a solenoid switch that will stand up under the most rugged requirements, always choose Tech Laboratories Solenoid Switches. These multi-pole units are built to "take it" and are designed and produced to meet your individual requirements.

According to your specifications you can get:

- Remote push-button operation, with or without manual reset.
- Single or dual direction operation.
- Single, or up to 8 decks.
- Single pole to 4 poles per deck.
- Two contacts up to several hundred contacts per deck.
- Shorting or non-shorting.
- Ceramic or phenolic insulation.
- Load capacities up to 10 Amp.—120 Volts AC (depending on number of contacts).
- Long, trouble-free service life.

Information on these and our additional line of motor operated switches is yours for the asking . . . Write today for complete catalog.

TECH LABORATORIES, INC.
Manufacturers of Precision Electrical Resistance Instruments
PALISADES PARK, NEW JERSEY

What to see at the Radio Engineering Show

(Continued from page 220A)

Popper & Sons, Inc.
New York 10, N.Y.
4-818

Marking equipment to print on electronic Components.

Potter & Brumfield, Princeton, Ind. 2-407
Relays and Electro Mechanical Assemblies

Potter Instrument Co.
Great Neck, N.Y.
1-113

New High Speed Digital Magnetic Tape Handler. High Speed Digital "Teldeltos" Recorder, Universal Frequency-Time Counters, Multiple Sequence pre-determined counters. High Resolution 8-mc Chronograph. Data Handling Equipment. Plug-in Decades, Shift Registers, Frequency Dividers.

Precise Development Corp., Oceanside, L.I., N.Y. 4-426 & 428
Voltmeters (Indicating Instruments) Low Voltage Power Supplies, Pulse Generators, Microwave & Radar Test Equipment. Oscilloscopes, Cathode-Ray. General Purpose General Test Equipment, Bridges, capacitance. Bridges, resistance.

Precision Apparatus Company, Inc.
Elmhurst, L.I., N.Y.
2-307

High quality electrical indicating instruments (meters electronic test and measuring instruments and accessories. Cathode-ray Oscillographs, Vacuum tube voltmeters, Cathode-ray tube testers, Vacuum tube testers, AM signal Generators, Sweep signal generators, Volt-ohm milliammeters etc.

Premier Metal Etching Co.
Rockville Centre, L.I., N.Y.
4-710

Etched & Lithographed metal, name plates, scales, Dials for Instruments, Radio-Electronic panels. Plate facilities to etch, under cut, recess, and pierce to close tolerances on all dielectrics clad with copper, brass, aluminum, silver, nickel or steel.

Premier Metal Products Co.
Bronx 67, N.Y.
4-509

Premier Metal Products Company will exhibit a complete line of precision built metal housings including desk panel, relay, enclosed relay and transmitter racks. Various types of cabinet—rack, grille, meter and door panels will be shown. Also a line of utility cases, blank chassis and other items for the electronic industry.

What to see at the Radio Engineering Show

Presto-Recording Corp.
Paramus, N.J.
Theater 3-306

See the new PRESTO RC-11 Tape Transport Mechanism in sound theater No. 3-306.

Presto Recording Corp., Paramus, N.J. Theater 3-306
Presto is showing for the first time a completely new line of tape recorders and tape reproducers. The mechanical innovations have resulted in a number of exceptionally fine professional units. Disc recorders and transcription turntables for professional use will also be displayed.

Price Electric Corp., Frederick 1, Md. 4-501
Husky Relays and controls for military and commercial uses. Specializing in hermetically sealed telephone type relays. Manufacturers of the RO-T-RY, the relay that resists vibration.

Product Development Co., Inc., Kearny, N.J. 3-115
UHF-TV and microwave antenna systems. Waveguide, coaxial transmission lines and related system components; parabolic reflectors, cavity fed corners and horn antennas for use to 2700 mc. Prodelin "Job Packaged" installations for antenna systems with complete site facilities including appropriate towers, shelters, etc. Provided planning and single source responsibility.

Production Tool & Fixture Co.
Oyster Bay, L.I., N.Y.
3-522

Introduction of "Tiny-Fix," a new miniature assembly fixture designed especially to eliminate problems in small wiring and assembly. "Tiny-Fix" the outcome of suggestions received at last year's IRE Show for a problem-eliminator, will be on display at Booth No. 3-522, along with PTF's new, revolutionary universal TV fixture adapter.

Pyramid Electric Co.
North Bergen, N.J.
2-310

Capacitors; Electrolytics, Dry Electrolytics, papers, oil papers, metallized papers.

REF Manufacturing Corp., Mineola, L.I., N.Y. 3-202
Presents a complete display of electronic units showing REF's functional type of Construction. The units shown have all bee expertly designed, engineered, fabricated and assembled by REF, in accordance with customer's specific requirements combining lightness, strength, appearance and low cost of manufacture.

Racon Electric Co., Inc., New York 3, N.Y. 3-315
Driver units, straight and re-entrant horns, Marine speakers, Tweeters, cone speaker enclosures, explosion-Proof driver units, Microphone stands. Also speakers for all Industrial and Military requirements.

Be sure to visit all four floors!

(Continued on page 224A)

WHY WIRE?

REDUCE YOUR COSTS with

"photocircuits PRINTED CIRCUITS"*

plus DIP SOLDERED electronic sub-assemblies

Mass produced "Photocircuits Printed Circuits" and dip-soldered sub-assemblies mean important reductions in time and cost factors in your production plans. Ask our Engineering Department about these and other benefits. An 8-page Engineering Information brochure available on request.

PC

* Trade Mark

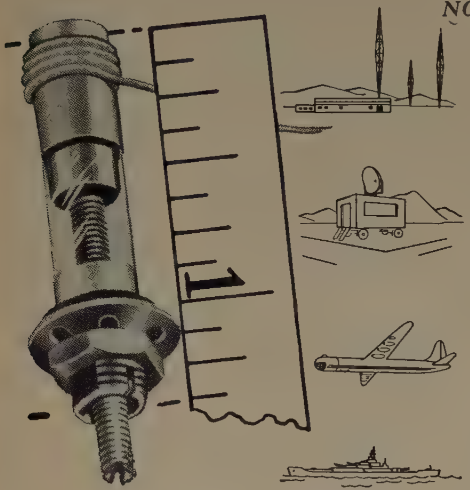
photocircuits CORPORATION

DEPT. IRE-3 • GLEN COVE • NEW YORK

Visit us at the IRE SHOW—Booth 4-102

JFD MFG. CO.
BROOKLYN 4, N.Y.
BENSONHURST 6-9200
world's largest manufacturer of tv antennas & accessories

leading manufacturers use
JFD PISTON TYPE VARIABLE TRIMMER CAPACITORS
in both civil and military equipment



NO OTHER LIKE IT!

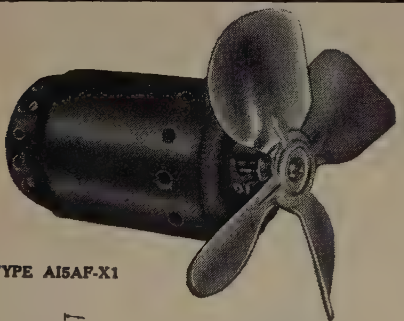
- Spring loaded piston made of special invar alloy having extremely low temperature coefficient of expansion.
- Silver band fused to exterior of precision drawn quartz or glass tube serves as stationary electrode.
- Piston dimensional accuracy is held to close tolerance maintaining minimum air gap between piston and cylinder wall.
- Approximately zero temperature coefficient for quartz and ± 50 P.P.M. per degree C. for glass units.
- "Q" rating of over 1000 at 1 mc.
- Dielectric strength equals 1000 volts DC at sea level pressure and 500 volts at 3.4 inches of mercury.
- 10,000 megohms insulation resistance minimum.
- Operating temperatures, −55 C. to +125 C. with glass dielectric. And −55 C. to +200 C. with quartz dielectric.
- Over 100 megohms moisture resistance after 24 hours exposure to 95% humidity at room temperature.

Write for Form No. 199

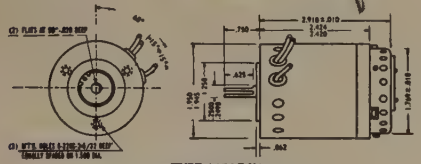
See Us at Booth 2-134, I.R.E. Show, March 23-26

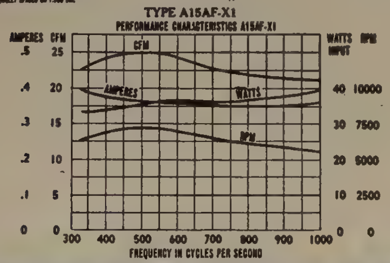
83-5378

PRECISION MOTOR PERFORMANCE



TYPE AI5AF-X1


(2) FLATS AT 90°-.020 DEEP
(3) MTG. HOLES 6-32NC-2A/32 DEEP EQUALLY SPACED ON 1.500 DIA.
.750
2.918±.010
2.424
2.420
.425
.062
1.750±.010



Axial fan blower, 3 phase self-cooled motor is designed to start at a —55° C and feature maximum possible H P per unit weight and volume. The temperature will rise 45° C when fully loaded with 4" 4 blade, 29 degree pitch fan; Silicone wire and impregnation. At full load the input is 94 watts, the line current .54 amperes and the efficiency is 60%.

SPECIFICATIONS
Conform to NEMA Standards and other Gov't specifications.
Continuous duty

WEIGHT	22 oz.
C F M	22 Average
R P M	6250 Average
VOLTS	115
CYCLES	320-1000

can be supplied CW and CCW suitable for 50 to 60 CPS

AIR MARINE MOTORS INC.
2183 JACKSON AVENUE, SEAFORD, L. I., N. Y.
WAntagh 2-7309

See Us at the I.R.E. Show, Booth 4-315, March 23-26

What to see at the Radio Engineering Show

(Continued from page 223A)

Radell Corp., Indianapolis, Ind. 4-121
Deposited Carbon Resistors

Radio City Products, Inc., New York 1, N.Y. 3-307B
Television and Radio Signal Generators, Multimeters, tube and set testers, Vacuum tube voltmeters, oscilloscopes and accessories.

Radio Corp. of America
Camden, N.J.
1-304-1-309

Electronic components, dry batteries, test and measuring equipment, Projectors, and UHF equipment.

Radio Corp. of America
Harrison, N.J.
1-304-1-309

Will exhibit a representative line of tubes used in INDUSTRIAL, ENTERTAINMENT, and MILITARY equipment. RCA Premium types, storage types, UHF-VHF Receiving and Transmitting types, Multiplier Phototubes, Industrial tubes and printed circuits will be featured.
The reflection-free characteristic of frosted filterglass face plates will also be demonstrated.

The RCA Laboratories Division, Princeton, N.J. 1-304-1-309
The RCA Laboratories exhibit will present various phases of electron solid state research with emphasis on transistors. Steps in germanium purification will be illustrated and a variety of devices using transistors will be displayed—some in operation.

Radio Materials Corp.
Chicago 18, Ill.
2-509

RMC "DISCAP" ceramic capacitors, By pass and temperature compensating disc, types, special purpose and special voltage types.

Radio Receptor Co., Inc.
New York 11, N.Y.
2-113

Manufactures of seletron selenium rectifiers, germanium and silicon (polarity at a glance) diodes, transistors, germanium power rectifiers, UHF converters and tuners, communications equipment, thermatron high-frequency dielectric heat sealing and wood glueing equipment.

Radio-Electronics, New York 7, N.Y. 2-141
Radio-Electronics is a highly technical magazine covering radio, television, high-fidelity, audio and the practical application of electronics with special emphasis on servicing, construction and new developments. Gernsback Publications, Inc., also publishes the Gernsback Library of low-cost technical books with titles on the theory, practice and application of radio, television and electronics at the service technician's level.

What to see at the Radio Engineering Show

Radio Magazines, Inc., Mineola, N.Y. 3-316
Audio Anthology—Reprints from Audio Engineering; 2nd Audio Anthology—Reprints from Audio Engineering; Audio Engineering—The magazine devoted solely to the science of reproduced sound.

Radio & Television News, New York 17, N.Y. 3-402
Magazines.

Radioactive Products, Inc., Detroit 26, Mich. 4-115
Instruments for detection and measurement of radioactivity.

RAWSON

R

for better
LABORATORY METERS
since 1918

Rawson Electrical Instr. Co., Inc., Cambridge 42, Mass. 2-412
Laboratory meters for AC or DC measurements, extremely high sensitivity. New improved Fluxmeter for testing magnets, may be used with any search coil from zero to 100 ohms! Rotating Coil Gaussmeters for magnetic field measurements, several new models. Electrostatic Voltmeters for voltage measurements with zero current drain. Sine-Cosine Potentiometers.

Raymond Engineering Lab., Inc., Middletown, Conn. 4-903
Magnetic fluid clutches for industrial control and servo-mechanism application.

Raytheon Manufacturing Co.
Waltham 54, Mass.
1-422, 424
Electronic equipment. Receiving tubes, plastics.

Reeves Instrument Corp., New York 28, N.Y. 1-423
The new C202 REAC, new miniature bread board parts, new miniature resolver and gyro, and the new six channel recorder.

Reiner Electronics Co., Inc., New York 1, N.Y. 3-307B
Limit Bridges, Square Wave Generators, Vacuum Tube Voltmeters.

The Rex Corp., West Acton, Mass. 3-119
Rex Kel-f Insulated hook-up wire. Rex Microwall hook-up wire. Rexolite #1422 UHF Insulating Material, rods and sheets. Rextrude electrical tubing, Underwriters' approved 105° C and service approval Per MIL-I-631A. Rex extruded Teflon rod. Rex custom extrusions to your specifications.

Rhode Island Insulated Wire Co., Inc.
Cranston, R.I.
4-703
A complete line of Insulated Wire including goverment specification wire.

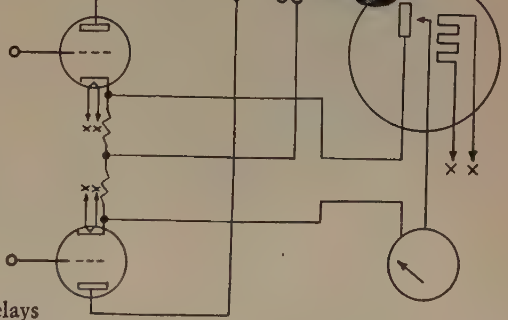
(Continued on page 226A)

Sensitive Galvanometer Used in Guided Missile Research...
INPUT LEVEL
OUTPUT CENTER
TEST METER
SUBCARRIER DISCRIMINATOR
ELECTRO-MECHANICAL RESEARCH, INC.
RIDGEFIELD, CONN.

...Protected by an
EDISON
Time Delay Relay

Malfunction or failure of recording equipment when a guided missile is fired can result in the loss of invaluable research data. The requirement of complete reliability of components used in conjunction with this equipment resulted in the selection of an EDISON Time Delay Relay as a vital part of the Model 46A Sub-Carrier Discriminator manufactured by Electro-Mechanical Research, Inc., Ridgefield, Conn.

The Edison Time Delay Relay is used to protect the sensitive galvanometer in the associated oscillographic recording unit, by allowing the power tube filaments to reach proper operating temperature before the application of high voltage. The thermal action is independent of line voltage variations since the delay characteristics vary in the same proportions as the heating of the filaments. Because of their cooling rate, EDISON relays prevent loss of equipment operating time due to momentary power interruptions.



Edison engineers will be glad to help solve *your* cathode protection problems. Just call or write to:

Thomas A. Edison
INCORPORATED
Instrument Division
Dept. 62, West Orange, New Jersey

AT THE I.R.E. SHOW, Grand Central Palace, March 23-26, be sure to visit the Edison booth—No. 4-714.

YOU CAN ALWAYS RELY ON EDISON

EDISON INSTRUMENTS

Radio Telemetering
Data Handling
Vehicle Instrumentation
High Speed Sampling

Research, Development, Design, and Production Services
Involving Specialized Application of the
Principles of Electronics, Mechanics, and Optics

ASCOP®
WE PROVIDE THE LEVER • YOU MOVE THE WORLD

Your Inquiries Are Invited — Wire, Write or Phone

APPLIED SCIENCE CORPORATION OF PRINCETON
P. O. Box 44, Princeton, New Jersey • PLainsboro 3-4141
See Us at the Radio Engineering Show—Booth No. 4-806

SQUARE PULSE GENERATORS for the MILLIMICROSECOND to MICROSECOND RANGE

Model 100
Square Pulse Generator

PRICE: $395.00 F.O.B. New York
Standard Rack Mounting

For Nuclear Pulse Work, Radar, TV, Wide Band Amplifiers, and in the design, calibration and servicing of fast electronic systems:

FOR THE FIRST TIME—A Square Pulse Generator with a rise time of one millimicrosecond (10^{-9} seconds) and a pulse width which can be varied from 2 millimicroseconds to several microseconds is commercially available. Both positive and negative pulses of a 100 volts maximum amplitude, into low impedance (such as 50 OHM cable) are generated; the pulse amplitude can be varied from 100 volts to .006 volts in 1 decibel steps by means of selector switches on the front panel. One, two, or more pulse outputs, each of which can be individually attenuated and delayed are available in various models.

For further details, write for bulletin P-1 or contact our Engineering Division.

ELECTRICAL AND PHYSICAL INSTRUMENT CORPORATION

Sales and Business Office
25 West 43 Street
New York 36, N.Y.
Telephone: LOngacre 4-8510

Engineering Division
42-19 27th Street
Long Island City, N.Y.
Telephone: STillwell 4-6389

What to see at the Radio Engineering Show

(Continued from page 225A)

John F. Rider Publisher, Inc., New York 13, N.Y. 3-523
Rider AM-FM Radio, Television and public address equipment service manuals; rider TEK-FILE (a monthly technical data service for TV Equipment); Textbooks on electronics, with emphasis on television, radio and allied subjects. A special service of the organization is the preparation of technical manuals for government, industry and civilian uses.

SHEET METAL FABRICATIONS
Custom Built Cases and Covers for Electrical Equipment
4-130
THE RIESTER & THESMACHER COMPANY
1526 W. 25th St. Cleveland, O.

The Riester & Thesmacher Co., Cleveland 13, Ohio. 4-130
Manufacturers of sheet metal enclosures displaying several items of custom built metal cabinets and housings for electrical and electronic devices in steel, aluminum and stainless steel.

Robinson Aviation, Inc.
Teterboro, N.J.
2-216 & 217

All-Metal Vibration Isolators and Shock Control Systems, Units and Devices. Engineered Mountings to customers exact requirements, and exceeding applicable performance specifications. MET-L-FLEX is the copyrighted designation for the ALL-METAL resilient cushions developed and pioneered by Robinson Aviation, Inc.

Rocket Distributors, Inc., Bayside, L.I., N.Y. 3-526
See: C & H Supply Co.

Rola Co., Inc., Cleveland 14, Ohio. 3-506 & 507
Loudspeakers, deflection yokes and flybacks, headphones, transformers: Audio types, hermetically sealed types, TV types.

Roller-Smith Corp.
Bethlehem, Pennsylvania
4-521

Ruggedized and Hermetically Sealed Instruments, JAN type Instruments, Switchboard and Portable Instruments, Indicating Relays, Rotary Switches, Precision Balances.

Rotron Mfg. Co., Inc., Woodstock, N.Y. 3-201
Latest new devices for cooling electronic equipment including: silicone fluid pumps, heat exchangers, mechanical refrigeration units, wide frequency range motors, multistage turbines, blowers, fans, transmitting tube supports and air interlocks.

Rutherford Electronics Co.
Culver City, Calif.
3-111

Manufacturers of Precision Lab. test instruments displaying: A-2 Time Delay Generator, provides accurate and variable time delays from .8 to 100,000 micro-seconds. A-4 Time delay generator from 10 microseconds to 10 seconds. B-2 Pulse Generator is a source of pulses of variable width, repetition rate, delay, and amplitude. D-2 Pulse Train Calibrator.

(Continued on page 228A)

ANNOUNCING!...

HARRISON

adds another famous line to its TREMENDOUS STOCK of Top Electronic Equipment

CHICAGO

CHICAGO TRANSFORMER

TRANSFORMERS

Really rugged, dependable transformers, built to "take it" during critical continuous service operation. Meet every circuit requirement: Power, Bias, Audio, Filament, Filter, MIL-T-27, Stepdown and others. One-piece, drawn-steel seamless design provides excellent electrostatic and magnetic shielding, with complete protection against adverse atmospheric conditions.

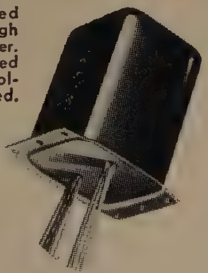
3 "Sealed-in-Steel" Case Mountings Available

H-TYPE

Hermetic sealing meets all MIL-T-27 specs. Steel base cover is deep-seal soldered into case. Terminals hermetically sealed. Ceramic bushings. Stud-mounted unit.

S-TYPE

Steel base cover fitted with phenolic terminal board. Convenient numbered solder lug terminals. Flange-mounted.



C-TYPE

With 10" color-coded leads brought out through fibre board base cover. Lead ends are stripped and tinned for easy soldering. Flange-mounted.

Free Catalog on Request

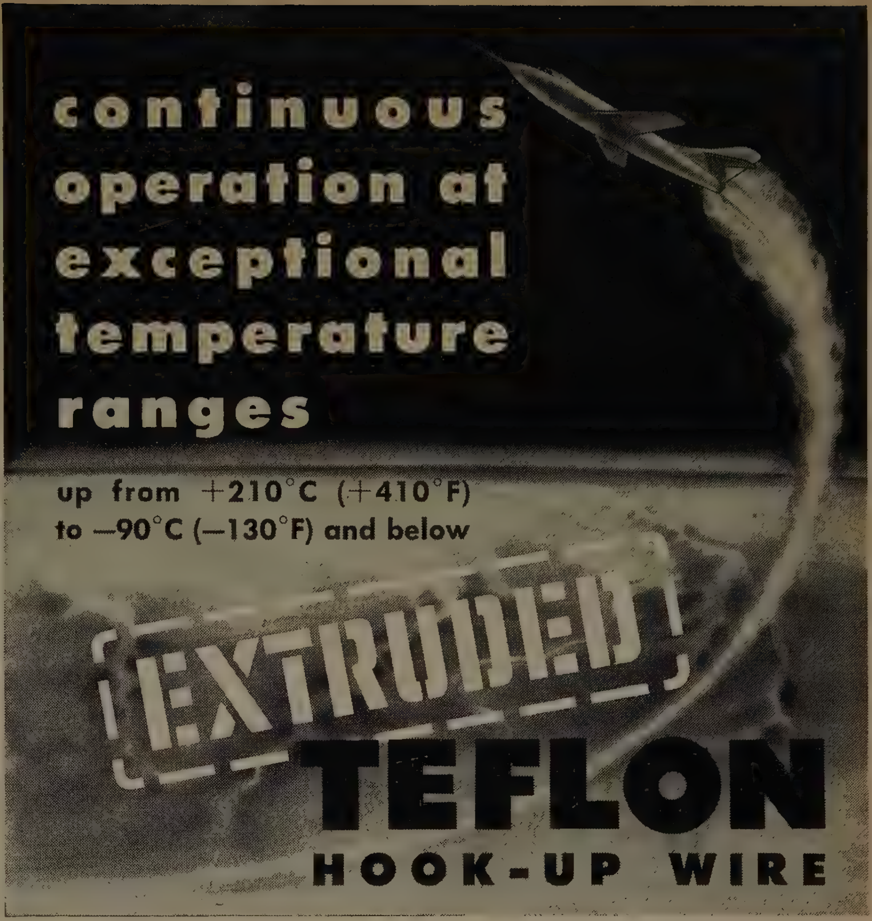
FREE!

To Purchasing Executives and Chief Engineers . . . Latest 1200-page encyclopedia of electronic parts and equipment. Write to Bert Schreiner on your company letterhead and mention your title.

Dependability — Since 1925!

● Phone BArclay 7-7777

HARRISON
RADIO CORP
225 GREENWICH STREET
NEW YORK 7, N.Y.


continuous operation at exceptional temperature ranges
up from +210°C (+410°F) to —90°C (—130°F) and below
EXTRUDED
TEFLON
HOOK-UP WIRE

EXTRUDED TEFLON (Tetrafluoroethylene) hook-up wire is organically capable of sustained operation from +210°C to —90°C with no appreciable decomposition. This wide range of operating efficiency continually opens new applications for **EXTRUDED TEFLON** — especially where constant stability under exceptional temperature conditions is required for long periods. **EXTRUDED TEFLON** +210°C to —90°C is non-inflammable . . . is resistant to most chemicals . . . has no known solvent.

Because of low electrical losses, **EXTRUDED TEFLON** is adaptable for high frequency use. It has very high volume and surface resistivity. **EXTRUDED TEFLON** is available in thin wall and specified hook-up wire sizes, with shield or jacket, also as coaxial cable.

NOW AVAILABLE in 10 colors—black, brown, red, orange, yellow, green, blue, violet, gray, white. Samples available.

See you at the IRE Convention
March 23-26, Booths 4-201, 4-202.

Surprenant MFG. CO.

199 WASHINGTON ST. BOSTON 8, MASS. Plant CLINTON, MASS.

Engineered Wire and Cable for the Electronic and Aircraft Industries

Burlington

HERMETICALLY AC-SEALED-DC INSTRUMENT

- Copper — cadmium — dichromate finished case.
- Black satin onodized aluminum bezel.
- Excellent shielding due to case material and construction.
- Double strength clear glass.
- Glass to metal seal under controlled humidity and temperature conditions.
- D'Arsonval permanent magnet type movement for DC applications.
- Magnetically damped, moving iron vane type movement for AC applications.

RUGGED CONSTRUCTION FOR SUPERIOR PERFORMANCE

- Available in 1½" square, 2½" and 3½" round case types.
- Guaranteed for one year against defective workmanship and materials.

Burlington "Hermetically Sealed" Instruments are designed to conform to JAN and MIL specifications.

B

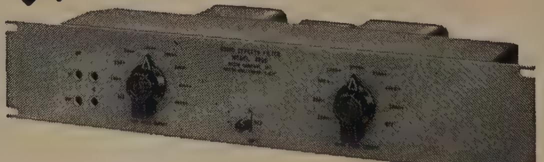
BURLINGTON INSTRUMENT COMPANY
DEPT. I-33, BURLINGTON, IOWA

See us at Booth 2-323, I.R.E. Show, March 23-26

HYCOR

TYPE 4200

Sound Effects Filter



This unit has been developed to meet present day requirements for compactness. The filter requires only 3½ inches of rack space.

Features . . .

- **LOW HUM PICKUP** through the use of toroid coils. The unit may be used in circuits having signal levels as low as —40 dbm without the necessity for taking special precautions against hum pickup.
- **LOW DISTORTION:** The filter may be used at levels up to plus 20 dbm with negligible intermodulation distortion.
- **RELIABILITY:** All capacitors and inductors are hermetically sealed for lifetime service. Aging effects are negligible.

General Specifications . . .

DIMENSIONS: Standard rack panel, slotted, 3½" high. Maximum depth 7½".
CONTROLS: Low frequency cutoff selector knob, high frequency cutoff selector knob, on-off key.
RANGES: Both low and high frequency cutoff controls cover 100, 250, 500, 1000, 2000, 3000, 4000 and 5000 cycles.
ATTENUATION: Approximately 16 db, per octave on both high and low frequency cutoff points.
IMPEDANCE: 500/600 ohms, in-out.
FINISH: Engraved panel finished in medium gray baked enamel. (Special colors available upon request.)
The filter has standard input and output jacks located on the front panel in addition to the terminal block at the rear.

11423 VANOWEN ST., NORTH HOLLYWOOD, CALIFORNIA
HYCOR Company, Inc.
SUnset 3-3860

Manufacturers of Precision Resistors, Toroid Inductors and Electric Wave Filters

REPRESENTATIVES:
Jack Beebe, 5707 W. Lake Street, Chicago, Illinois
George E. Harris & Co., Box 3005, Municipal Airport, Wichita, Kansas
Marvin E. Nulsen, 5376 E. Washington St., Indianapolis 19, Indiana
Burlingame Associates, 103 Lafayette Street, New York City

For further information contact your nearest Hycor representative or write for Bulletin S

What to see at the Radio Engineering Show

(Continued from page 226A)

St. Regis Paper Co., New York 17, N.Y. See Panelyte Div. 4-619 & 621

Sanborn Company
Cambridge 39, Mass.
2-116

New Series of direct-writing recording systems. Features of the new systems (Model 150 Series) to be shown and demonstrated will include: standard relay reack design; improved paper drive with selection of 9 speeds; individual stylus temperature control; and a basic amplifier and power supply assembly providing for plug-in installation of individual amplifiers and preamplifiers, including: AC-DC, Carrier (strain gage), Coupling, Log-Audio, Servo Monitor, DC Converters (Chopper).

Those who know ...choose Sangamo

SANGAMO

3-510

Sangamo Electric Co., Capacitor Div., Marion, Ill. 3-510
A complete line of radio and electronic capacitors, featuring such Sangamo developments as: HUMIDITE . . . the new plastic molding compound that offers previously unheard-of moisture resistance. E-THERM . . . an impregnant for oil paper capacitors that permits 125° operation. TELECHIEF . . . new premium molded tubular capacitor that's resin-impregnated and molded in Humiditite.

Scheidl Manufacturing Co.
Copaigue, L.I., N.Y.
4-416

Panel and Control Box Assemblies. Machine Details. Edglight Panels made to MIL-P-7788 specifications. Reinforced Plastic Housings for Electrical Units. Low Pressure Laminating. Precision and Vacuum Forming.

Carl W. Schutter Mfg. Co., Lindenhurst, L.I., N.Y. 2-205
RADAR AND ELECTRONIC COMPONENTS.

Scientific Electric
Garfield, N.J.
1-605

Scientific Electric, Designers and Manufacturers of High Frequency and High Voltage equipment since 1921 invite you to visit their exhibit to see the latest: High Frequency Vacuum Tube Bombarders, Induction and Dielectric Heaters, High Voltage Power Supplies, Precision Spot Welders.

Scientific Specialties Corp., Boston 35, Mass. 4-822
Specialized laboratory instruments for workers in Nuclear Physics Histology, Pathology, and Ophthalmology, as well as the new products of associate Transistor Products, Inc. including Transistors, Gold Bonded Germanium diodes & a Transistor Test Set.

What to see at the Radio Engineering Show

Secon Metals Corporation
New York 17, New York
4-506

Special Metallurgical Items Including Fine Wire and Ribbon and Components in Electronic Vacuum Tubes.

Servo Corp. of America
New Hyde Park, L.I., N.Y.
3-524

Servomechanisms, analyzers, Servotherm Thermistor Bolometers & accessory equipment, sub-audio generators and direction finding equipment.

Servomechanisms, Inc.
East Coast Division & Home Office
Post and Stewart Avenues
Westbury, Long Island, N.Y.
Westbury 7-2700
4-207 & 208

SERVOmechaNISMS
PACKAGED FUNCTIONAL COMPONENTS

West Coast Div.
316 Washington St.
El Segundo, Calif.
El Segundo 1517

Servomechanisms, Inc., Westbury, L.I., N.Y. 4-207 & 208
"Designers and manufacturers of electronic and electromechanical components and systems. Featuring functionally packaged plug-in components, instrument motors, mechanical development apparatus, recorders, transducers, and automatic control systems for both 60 cycle and 400 cycle applications.

The Sessions Clock Co., Forestville, Conn. 3-107 & 108
Switch Timers for clock radios. Miniature Snap-Action Switches. Timing motors, movements, and switches for industrial applications.

Shallcross Mfg. Co.
Collingdale, Pa.
2-210 & 211

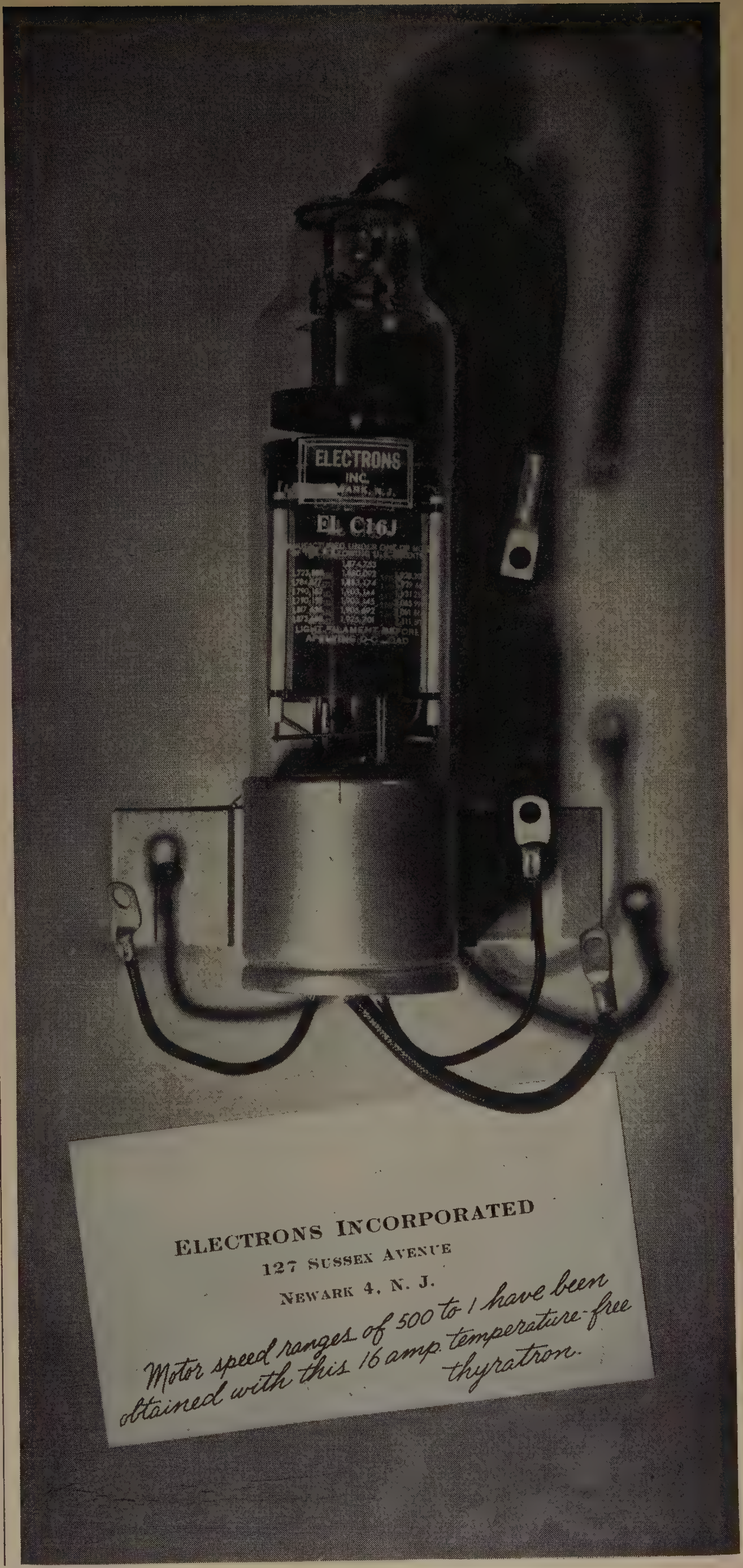
Precision wire-wound resistors; Rotary Selector Switches; Audio Attenuators; Decade Resistance; Voltage Dividers; Resistance Standards; Low Resistance Test Sets; Wheatstone Kelvin-Wheatstone Bridges; Wheatstone-Megohm, Percent Limit and Fault Location Bridges; High Voltage Measuring Apparatus; Telephone Transmission Test Set Equipment; Galvanometers.

Sheldon Electric Co., Div. of Allied Electric Prods. Inc., Irvington 11, N.J. 3-206 & 207
Cathode-Ray Tubes, Receiving Tubes, Tiago Tube & Adapter, Spring-Action Plugs, Fluorescent Starters, Time Delay Relays.

Shielding Inc., Riverside Park, N.J. 4-114
Screen rooms and filters.

F. W. Sickles Division. SEE General Instrument Corp. 4-518

(Continued on page 230A)


ELECTRONS
INC.
NEWARK, N.J.
EL C16J
LIGHT FILAMENT BEFORE APPLYING D-C LOAD
ELECTRONS INCORPORATED
127 SUSSEX AVENUE
NEWARK 4, N. J.
Motor speed ranges of 500 to 1 have been obtained with this 16 amp. temperature-free thyratron.

HIGH TORQUE-
LOW INERTIA

SERVO MOTOR

100% Solid Impregnation
of Windings
Using—
EPOXY RESINS

MK-7 MOD-0
MK-7 MOD-1
MK-7 MOD-2

To provide driving means for control type synchros, through amplifier, for continuous synchro "null" positioning—for plate to plate control—for servo mechanism systems requiring two phase A.C. motors with low inertia and high torque rating.

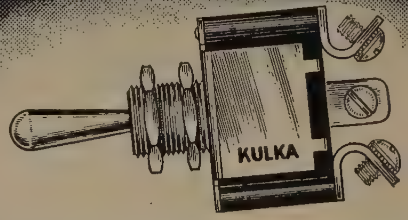
STANDARD TYPES—30 DAY DELIVERY
SPECIAL REQUIREMENTS CAN BE MET

$\frac{1}{2} I \omega^2$

KINETIX INSTRUMENT CO., INC.
902 BROADWAY, NEW YORK 10, N. Y.

KULKA

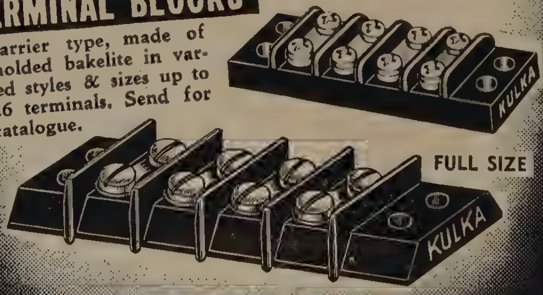
Single and Double Pole "Toggle" Handle Type
AIRCRAFT SWITCHES
For Electronic and Communications Use



Made to JAN specs for DC, or AC circuits up to 1600 cycles. Available with screw terminals and with soldering lugs. Switching characteristics provide for changes in electric circuits by use of SPST, SPDT, DPST and DPDT. Has bakelite housing and only one mounting hole.

TERMINAL BLOCKS

Barrier type, made of molded bakelite in varied styles & sizes up to 26 terminals. Send for catalogue.



KULKA ELECTRIC MFG. CO., Inc.
MOUNT VERNON, N. Y.

See Our Exhibit IRE Show—Booth 2-139

What to see at the Radio Engineering Show

(Continued from page 229A)

Sigma Instruments, Inc., Boston 85, Mass 2-311
Sensitive AC, DC, Polar, and Telegraphic Keying relays, Available as standard relays with general purpose adjustments or as specified relays adjusted and adapted for particular requirements involving unusual or exacting circuit behavior. Application engineering service available. Fourteen page catalog on request.

Simpson Electric Company
Chicago 44, Ill.
1-128

See an amazing engineering advance in panel meters! For the first time, the Simpson core movement is on display. And, for a complete line of panel meters of all types together with a diversified selection of easy to use radio, television and industrial test equipment.

Herman H. Smith, Inc., Brooklyn 15, N.Y. 3-511
Electronic Components and Radio Hardware.

Sola Electric Co.
Chicago 50, Ill.
1-405

Sola Constant Voltage Transformers, Sensivolt AC Control Units, and related products.

Sorensen & Co., Inc.
Stamford, Conn.
2-318 & 319

AC Line Regulators, electronic, 60 & 400 cps; Regulated DC supplies, both high and low voltage, high and low current; Electronic Frequency changers, 0.01% accuracy; AC regulator and Spectrophotometer Power Supply.

Southwestern Industrial Electronic Co.
Houston 19, Texas
4-116 & 117

Electronic Test Instruments—Oscillators; Resistance Meters; DC Amplifiers: Vacuum Tube Voltmeters & Potentiometers; Impedance Bridges; Special Amplifiers & Power Supplies.

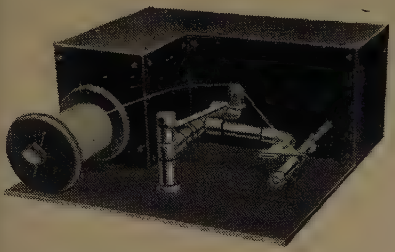
Speer Resistor Div. of Speer Carbon Co., St. Marys, Pa. 4-127
Fixed Carbon Composition Resistors, Condensers, Capacitors and other electronics parts.

Spencer-Kennedy Laboratories, Inc.
Cambridge 39, Mass.
2-142

Be sure to see our new extended range Chain Amplifiers at Booth 2-142.

(Continued on page 232A)

NEW
ALCAR MODEL 101
UNIVERSAL COIL WINDER



A completely self-contained, self-powered unit for winding pi or universal coils of variable width, to a diameter of 4 inches.

The model 101 will provide the development or design engineer with a precision source of experimental coils, and is suitable for small production.

Unit is complete
no accessories required

ALCAR
INSTRUMENTS, INC.
2 Godwin Ave.
Fairlawn, N.J.
Fairlawn 6-0007

GTC

invites you
to visit
Booth #4-310
at the I.R.E. Show
and
the General Transformer suite
at the Hotel Commodore
4-7 P.M. daily

"GTC"—specified for the usual—

—demanded for the unusual!

GENERAL TRANSFORMER CO.
18240 Harwood Avenue
Homewood, Illinois
(Suburb of Chicago)

---

p

POLYPENCO TEFLON*

available for economical fabrication

ROD	Extruded .187″ dia. to 2.0″ dia. Tolerance +.002″—.000″ up to 1″ dia. Molded 2.25″ dia. to 4.0″ dia. Beading .030″ to .187″ dia.
TUBING	Extruded .50″ to 2.0″ O.D. 3/16″ to 1.0″ I.D. min. wall ⅛″ Molded 1¼″ to 8″ O.D. at ¼″ intervals Wall thickness ⅜″—2¾″
OTHER SHAPES	Strip thickness .002″ to .060″ Slab thickness ⅛″ to 1½″ Special extruded shapes to customer specifications

Outstanding properties of TEFLON

Advantage	
WIDE SERVICE TEMPERATURE RANGE	−100°F to +500°F
CHEMICALLY INERT	Resists all known acids, alkalies and commercial solvents over the service temperature range.
ZERO WATER ABSORPTION	Water will not wet the surface.
LOW POWER FACTOR	.05% p.f. constant over entire frequency spectrum.
STABLE DIELECTRIC CONSTANT	2.0 unchanged over entire spectrum.
TOUGHNESS AT LOW TEMPERATURE	Izod impact strength −70°F 2 ft. lbs./in.

also available to your specifications

MACHINED PARTS • MOLDED PARTS

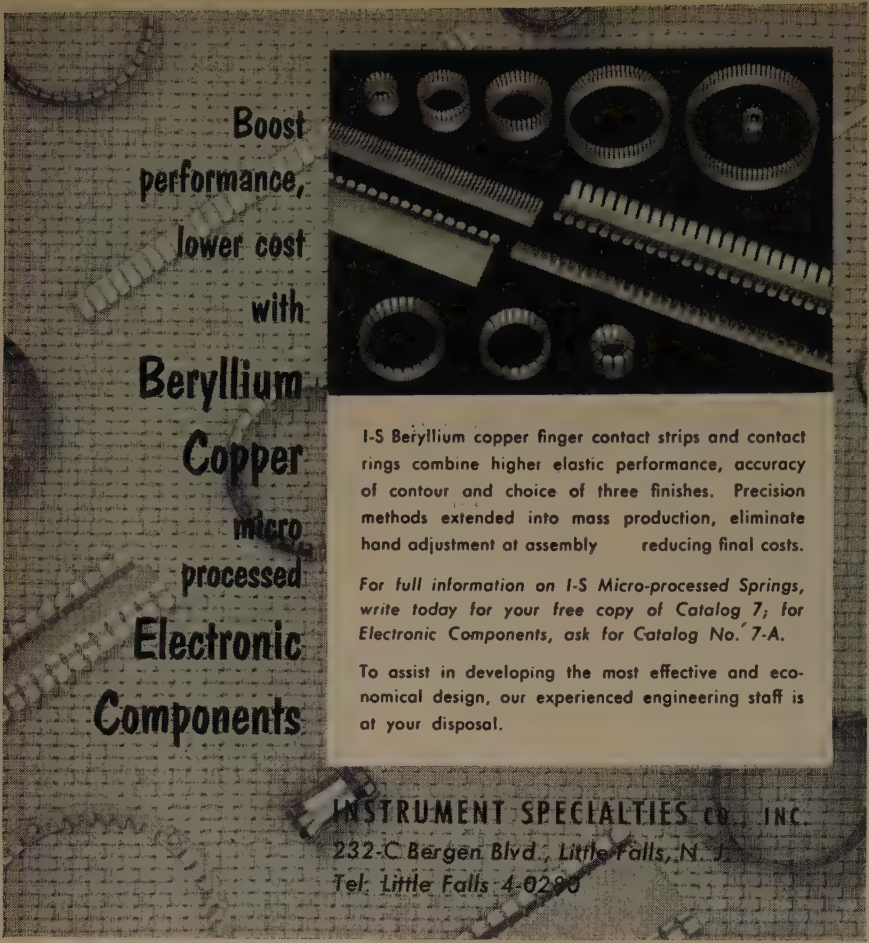
*Teflon is a trademark of E. I. DuPont.

POLYPENCO® / **nylon teflon**

Write for technical data and prices on Polypenco Teflon and Nylon

The POLYMER CORPORATION of Pennsylvania • Reading, Penna.

"Canadian Representative: C-H Engineering Company, Montreal, Toronto, Canada



Boost performance, lower cost with Beryllium Copper micro processed Electronic Components

I-S Beryllium copper finger contact strips and contact rings combine higher elastic performance, accuracy of contour and choice of three finishes. Precision methods extended into mass production, eliminate hand adjustment at assembly reducing final costs.

For full information on I-S Micro-processed Springs, write today for your free copy of Catalog 7; for Electronic Components, ask for Catalog No. 7-A.

To assist in developing the most effective and economical design, our experienced engineering staff is at your disposal.

INSTRUMENT SPECIALTIES CO., INC.
232-C Bergen Blvd., Little Falls, N. J.
Tel: Little Falls 4-0280

What to see at the Radio Engineering Show

(Continued from page 230A)

Spencer-Kennedy Labs., Inc., Cambridge 39, Mass. 2-142
Be sure to see the new extended bandwidth Model 214B Chain Pulse Amplifier and 202C Wide-Band Chain Amplifier; the new 212A-TV Television Amplifier with again control and connection for automatic level control. See SKL's Variable Electronic Filters. Wide-Band Distribution System, new pulse and square wave generators, and high speed oscilloscope.

Sperry Gyroscope Company

Visit booths 1-607, 1-609, 1-611 for the latest klystrons and microwave test equipment. New X-Band models exhibited for first time.

Sperry Gyroscope Co. Div., The Sperry Corp., Great Neck, L.I., N.Y. 1-607, 609, 611
Celebrating its fifteenth anniversary in the klystron and microwave test equipment business, Sperry will exhibit latest designs of klystrons for local oscillator, medium power transmitter, high power transmitter, bench oscillator and multiplier service. Latest designs of field test equipment and automatic production testing equipment at microwave frequencies will be featured.

Visit all four floors

BENDIX FRIEZ

Just right for your job!

high-precision thermistors by **BENDIX-FRIEZ**

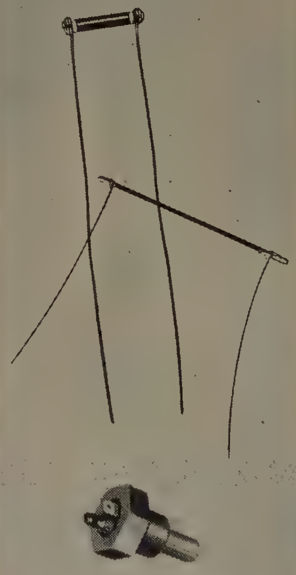
As temperature measuring elements and liquid level sensors, these temperature responsive resistors are the best you can buy. In standard or special types, their high-precision manufacture makes them precisely right for your job when it comes to resistance values, size, temperature coefficient, mountings and quality. Ask us about applications.

STANDARD TYPES FOR IMMEDIATE DELIVERY

Size (inches)	@ +30°C.	@ 0°C.	@ −30°C.
.140 x .75	45.0 ohms	86 ohms	194 ohms
.040 x 1.5	12,250 ohms	26,200 ohms	65,340 ohms
.018 x 1.5	35,000 ohms	82,290 ohms	229,600 ohms

Write for information about Bendix Friez Weatherman lobby installations

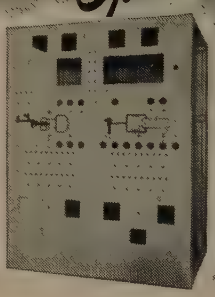
FRIEZ INSTRUMENT DIVISION of . .
1490 Taylor Avenue, BALTIMORE 4, MARYLAND
Export Sales: Bendix International Division
72 Fifth Avenue, New York 11, N. Y.



Used in this typical application for sensing the temperature of hydraulic oil.

Bendix
AVIATION CORPORATION

FALSTROM
Panelboard Specialists!



CUSTOM BUILT
CABINETS ENCLOSURES
HOUSINGS CONSOLES

SUB-ASSEMBLIES in aluminum, steel, stainless steel. From 18 gauge to ¼ inch plate. Long or short runs. Write for new bulletin.

Visit us at the I.R.E. ELECTRONICS SHOW, Grand Central Palace, March 23 to 26. Booth 4-507.

FALSTROM COMPANY
56 Falstrom Court, Passaic, New Jersey
ENGINEERS • DESIGNERS • FABRICATORS SINCE 1870

What to see at the Radio Engineering Show

Sprague Electric Co.
North Adams, Mass.
1-410, 412

Capacitors, resistors, Ferroxcube Cores, pulse networks, radio interference locators.

Square Root Mfg. Corp., Yonkers 5, N.Y. 2-520
Television Components, Toroidal Coils, Transformers, Filter Networks.

Standard Electric Time Co., Springfield 2, Mass. 4-417
New line of ELECTRONIC COUNTER TIMERS and TACHOMETERS featuring: (a) Compact Units (b) New Readout Indicator (c) plug-in Component Parts Construction. 400 Cycle Timer. d-c Motored Timer. Lab. Power Distribution Panels.

Standard Piezo Co., Carlisle, Pa. 2-305
Crystals (Oscillating), and Accessories. Crystal holders. Crystal ovens.

Standard Transformer Corp.
Chicago 18, Illinois
BOOTH 4-801

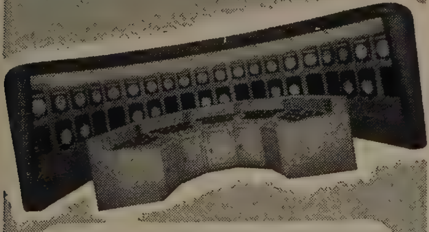
DON'T MISS STANCOR'S ULTRA-MINIATURE TRANSISTOR TRANSFORMERS

STANCOR

The smallest iron core audio transformer ever built.

(Continued on page 234A)

FINE INSTRUMENTS *deserve* FINE PANELS



QUALITY METAL FABRICATING for AVIATION INSTRUMENTS, AUDIO COMPUTORS, TELEVISION, RADIO, RADAR, FACSIMILE

DESIGN AND ENGINEERING SERVICE. Falstrom engineers will work with your staff from the planning stage to fill your needs efficiently and economically. For complete data write for illustrated bulletins; for consultation on a specific problem contact a Falstrom engineer. Visit us at the I.R.E. ELECTRONICS SHOW, Grand Central Palace, March 23 to 26. Booth 4-507.

FALSTROM COMPANY

56 Falstrom Court, Passaic, New Jersey

ENGINEERS • DESIGNERS • FABRICATORS SINCE 1870

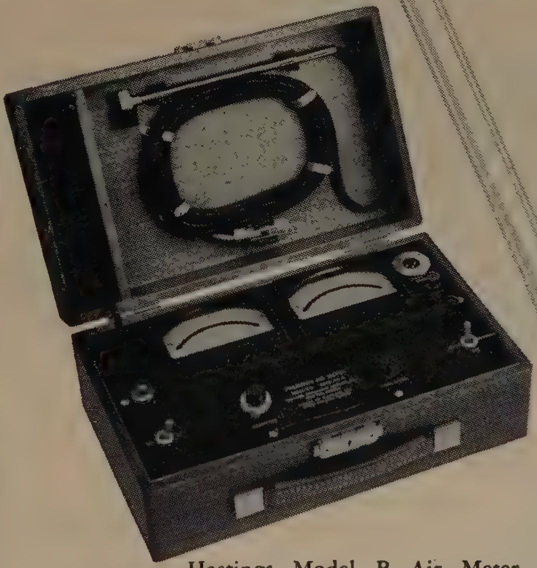
MEASURE AIR VELOCITY DIRECTLY AND ACCURATELY *WITH A* HASTINGS AIR-METER

The most sensitive of all air meters for research, industrial and agricultural applications. Reads directly in feet-per-minute on a logarithmic-type scale expanded at lower velocities. Highly sensitive — will indicate the velocity of smoke rising from a cigarette. Response time less than one second. Accurate to within ± 2% regardless of ambient temperature or static pressure.

Uses the exclusive Hastings noble metal thermopile in an extremely stable circuit. Instantaneous range switching without recalibration. Probes available for directional or non-directional reading. Easily adapted for remote recording since the calibration is independent of lead length. Available in several models to meet your specific requirements.

Hastings Model H Air Meter. Compact unit for field and laboratory use. Velocity Ranges: 10-750 fpm; 750-5500 fpm.

Hastings Model G Air-Meter. Small hand type instrument. Velocity range: 0-6000 fpm; Weight: 26 ounces.



Hastings Model B Air Meter for measurements of greatest precision. Velocity ranges: 0-400 fpm; 400 to 6,000 fpm. Meter type continuous calibration check. Knife edge, parallax free indicator.

Write for descriptive literature and prices on Hastings Air Meter, Manometer and Flowmeters, and Vacuum Gauges.

HASTINGS INSTRUMENT COMPANY, INC.

H/co

HAMPTON, 33 VIRGINIA

DESIGNERS AND BUILDERS OF RAYDIST AND SPECIAL ELECTRONIC, ELECTRICAL, AND MECHANICAL INSTRUMENTS

NEY

PRECIOUS
METAL ALLOYS AND
COMPLETE ASSEMBLIES

IMPROVE INSTRUMENT PERFORMANCE

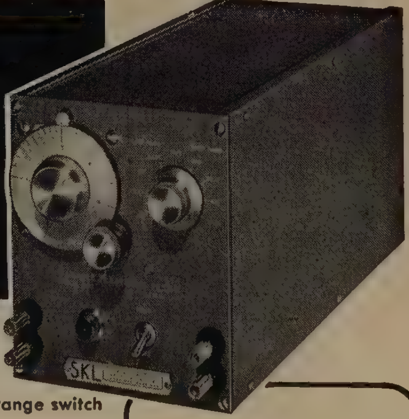
Paliney*#7, Ney-Oro G, Ney-Oro #28, and Ney #90 Alloy are precious metal alloys developed in the laboratories of the J. M. Ney Company for the fabrication of contacts, brushes, wipers, slip rings, commutator segments, and similar components used in precision control and instrumentation. Each alloy has specific qualities which mean greater accuracy and prolonged instrument life, as well as resistance to most corrosive industrial atmospheres.

Parts fabricated from Ney's Precious Metal Alloys are now components of instruments used in navigation, recording, computing, and many other devices. Consult the Ney Engineering Department for assistance with your problems.

*Reg. Trade Mark J. M. Ney Co.

THE J. M. NEY COMPANY • 171 Elm Street, Hartford 1, Conn.
Specialists in Precious Metal Metallurgy Since 1812

3NY53



MODEL 300
VARIABLE
ELECTRONIC
FILTER

Two simple controls are all that are necessary to operate the Model 300 Variable Electronic Filter. With the variable frequency dial and range switch any cut-off frequency from 20 cps to 200 KC may be quickly and accurately selected and reselected. With the range switch either low-pass or high-pass filter action may be chosen. In either case the rate of attenuation is 18 db per octave and the insertion loss 0 db. For higher rates of attenuation or continuous band pass operation two or more sections can be cascaded. Its low noise level and flexibility of operation make the Model 300 indispensable in geophysical and acoustic research, industrial noise measurements, in the automotive and aircraft industries as well as the radio broadcasting, recording and motion picture studio.

Write for further information today.

SPECIFICATIONS

- CUT-OFF RANGE 20 cps to 200 KC
- ATTENUATION RATE 18 db per octave
- SECTIONS Single, can be high pass and low pass
- INSERTION LOSS 0 db
- PASS BAND LIMITS 2 cycles to 4 MC
- NOISE LEVEL 80 db below 1 volt

SKL SPENCER-KENNEDY LABORATORIES, INC.
181 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

See Us at Booth 2-142, IRE Show

What to see at the Radio Engineering Show

(Continued from page 233A)

Standard Transformer Corp., Chicago 18, Ill. 4-801
The world's smallest transformers—Stancor Uutra-Miniature Transistor Transformers, will be displayed. In addition, there will be a complete exhibit of all types of hermetically sealed transformers that meet MIL-T-27 specifications, as well as all types of units for TV, radio, audio and other electronic applications.

Stelma, Inc., Stamford 1, Conn. 2-125 & 126
SEE C. G. S. Laboratories, Inc.

George Stevens Mfg. Co., Chicago 30, Ill. 4-516
We are exhibiting and demonstrating machines for winding almost any type of coil, including armature, bobbin lattice wound, variable pitch, random wound, resistor coils, solenoid, space wound, repeater, choke and toroidal coils. Models exhibited will include the new TW-A Tronidal Coil Winder and the new High speed bobbin Winder.

Stevens Mfg. Co., Inc., Mansfield, Ohio 2-140
"Display of bimetal thermostats, adjustable, non-adjustable, open, closed, hermetically sealed, such as are so widely used by the electronic and aviation industry. The display will include both snap-acting, that is, quick make and quick break, as well as, positive-acting. Also manual resets will be available."

PRODUCTS FOR THE
WORLD OF ELECTRONICS

Booth No.
3-105

STUPAKOFF CERAMIC & MANUFACTURING CO.
Latrobe, Pennsylvania

Stupakoff Ceramic & Mfg. Co., Latrobe, Pa. 3-105
Multi-Metal specializes in MuMetal shields, aluminum cabinets and chassis. Racks, panels, watertight units, and dial plates are precision engineered to customer's specs.

Superior Electric Co., Bristol, Conn. 1-103 & 104
On display in booths 1-103 and 1-104 will be the complete line of products manufactured by The Superior Electric Co. These include Powerstat variable transformers; Stabiline Automatic Voltage Regulators; Varicell DC Power Supplies; Voltbox AC Power Supplies and Superior 5-Way Binding Posts. This new, colorful display will be of interest to those in the Electrical, Electronic and Engineering fields.

Surprenant Mfg. Co.
Clinton, Mass.
4-201 & 202

New development, high temperature (+210° C to — 90° C) extruded Teflon (tetrafluoroethylene) hookup wire in small sizes with thin wall insulation available in standard colors. Engineered wire and cable for the Electronic and Aircraft Industries. Surflene (high temperature +130° C) wire and cable, coaxial cables, multiconductor cables, electrical tubing, special cables made to specification.

Wally B. Swank, Syracuse 4, N.Y. 4-612
Switches, Special molded parts.

VISIT THE SWITCHCRAFT BOOTH 3-114 and see the new "LITTEL PLUG," JAN type PJ-068, the JACK & BOOT ASSEMBLIES, and other new developments constantly broadening the line of quality JACKS, PLUGS and SWITCHES.

SWITCHCRAFT INC.

1238-30 N. Halstead St.
Chicago 22, Illinois

(Continued on page 237A)

Specified for Precision Performance!

STANDARD PACKAGED PUSH-PULL MAGNETIC AMPLIFIERS

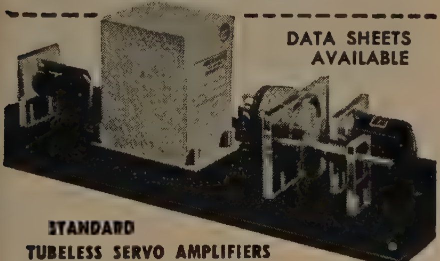
by MA

MAGNETIC AMPLIFIERS— These high gain, high performance Magnetic Amplifiers are especially suitable to drive two phase induction servo motors requiring from 0.1 watt to 20 watts per phase on either 400 cps or 60 cps powerlines. The output power is either in phase or 180 out of phase with the powerline depending on the D.C. input signal polarity.

SATURABLE TRANSFORMERS, REACTORS

Lower power gain, Magnetic Amplifiers designed to drive two phase induction motors. Output powers available are from 0.5 watt to 1000 watts, 400 or 60 cps. Catalog available.

DATA SHEETS AVAILABLE



STANDARD TUBELESS SERVO AMPLIFIERS

with built-in adjustable SERVO LOOP STABILIZATION. Packaged, completely self-contained, magnetic servo amplifiers for position servo systems where either A.C. or D.C. error signals are available. Designed for instrument type and power type servo systems to work with synchro control transformers or potentiometers and two phase induction servo motors.

Facilities Know-How to Engineer Design and Manufacture MAGNETIC SERVO AMPLIFIERS, VARIABLE SPEED DRIVES, MAGNETIC VOLTAGE, CURRENT FREQUENCY REGULATORS

Where the standard units do not meet your requirements our engineering facilities are available to work with you on overall system design.

MAGNETIC AMPLIFIERS • INC

An Affiliate of General Ceramics & Steatite Corp.
632 TINTON AVE., NEW YORK 55, N. Y.
Telephone: CYPRESS 2-6610

On display at I.R.E. Show • Booth 4-206

First Showing...

New Miniature... OSCILLOGRAPH RECORDER

AT THE RADIO ENGINEERING SHOW... BOOTH 3-212

$10\frac{1}{8}$" x 6" x $4\frac{1}{4}$"

Weight 15 lbs.

Heiland Type 35-50
12 channels

Heiland

The new Heiland Type 35-50, using 35mm. or 50mm. paper or film, has been designed and developed to meet an increasing demand by engineers and scientists for a small, lightweight recorder with accuracy of amplitudes and timing. All the features generally found only in much larger recorders are incorporated in the new, versatile and rugged Type 35-50.

Features...

- Remote speed control... 8 recording speeds
- Up to 12 galvanometers... electromagnetically or fluid damped
- Complete "no record" warning system
- Integrated magazine... capacity 100' of 35mm. or 50mm. film or paper
- Precision electronic timing
- Event marker
- Trace identifier
- Visual monitoring
- Record numbering
- Film or paper footage indicator
- All Operating Controls on one surface

Also on exhibit at the show...

• The new Heiland bridge balance and strain indicator. • The new Heiland solid-frame galvanometers. • The versatile Heiland 708B recorder... up to 24 channels ...for rack or table mounting.

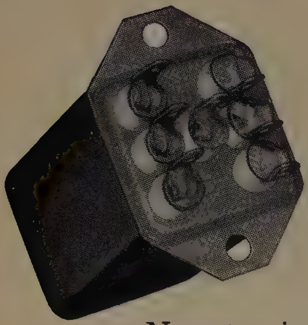
A New Recording Principle will be demonstrated at the show by Dr. C. A. Heiland of the Heiland Research Corporation in a lecture entitled "Radiation-Beam Oscillography with Immediate Trace Development."

Gold Hall, 7:30 P.M.
Tues. & Thurs., March 24 & 26

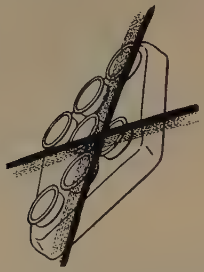
If you cannot attend the show, write or wire for a complete catalog of Heiland instruments.

The Heiland Research Corporation 130 EAST FIFTH AVENUE
DENVER, COLORADO

little terminal . . .
BIG performance



No extrusion needed for mounting this terminal!



NOW, an entirely *New* miniature hermetic terminal — Lundey series 199, which offers: the superior properties of TEFLON and silicone rubber; effective spring loading.

This terminal is assembled with simple tooling in a drilled or punched hole. As an extra service, Lundey Associates will supply the terminals installed in your covers, if desired.

These important features will help solve YOUR terminal problems —

- Teflon external member
- silicone or neoprene core
- minimum mounting — 15/64″ on centers
- voltage rating — 500V RMS operating
- current rating — 8 amps.
- three electrode styles:
    - eyelet with hollow conductor
    - single turret with solid conductor
    - double turret with solid conductor
- production-proved
- meets MIL-T-27 specifications

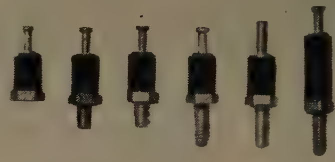
Send for your samples and Bulletin #P199

LUNDEY ASSOCIATES

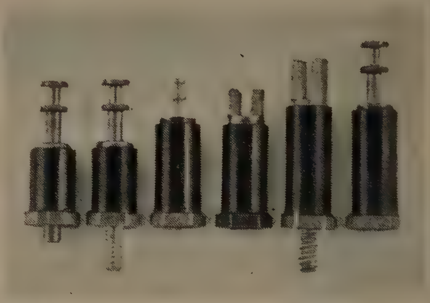
694 MAIN STREET · WALTHAM 54, MASSACHUSETTS

NOW . . . smallest practical sizes
GARDE
MINIATURE
Insulated Standoff
TERMINALS
Molded Melamine Insulation
in accordance with latest revisions of
Mil-P-14 Specification

▼ **SUBMINIATURE**



▼ **MINIATURE**



▼ **FEED-THRU** (HARDWARE INCLUDED)

Terminal and Mounting Insert styles shown are available in all body sizes (3/8″, 17/32″, 19/32″)

OTHER TYPES AVAILABLE

For specific details, write

GARDE
MANUFACTURING CO.
588 Eddy Street, Providence 3, R. I.
REPRESENTATIVES in Principal Cities

What to see at the Radio Engineering Show

(Continued from page 234A)

Switchcraft, Inc., Chicago 22, Ill. 3-114
Recent additions to the line, such as, the #480 Littel Plug (JAN type PJ-068), the Jack and Boot Assemblies, JACK COVERS, TELEVER SWITCH, ADAPTERS, in addition to the standard JACKS; Telephone and Microphone Plugs; Push Button, Rotary and Lever-Action Switches.

Sylvania Electric Products, Inc.
New York 19, N.Y.
2-102

Sylvania will exhibit new tubes for use in UHF, Subminiatures, Klystrons, Magnetrons, a story on tests conducted by an independent laboratory which depicts the quality of Sylvania Television Picture Tubes plus a complete line of parts for use in radio and TV manufacture.

Sylvania Electric Products, Inc., Tungsten & Chemical Div., New York 19, N.Y. 1-106, 107 & 108
Sylvania will exhibit tungsten and chemical products for the electronic industry that meet the highest standards of purity, precision, and uniformity. Tungsten wire and rod, gold-plated tungsten wire, hand wound coils, cathode ray tube phosphors, potassium silicate, carbonate emission coatings, silicon powder are among the noteworthy products to be displayed.

Synthane Corporation
Oaks, Pa.
2-129

Laminated plastic products sheets, rods, tubes, molded macerated, molded laminated, also fabricated plastic parts.

Tech Laboratories, Inc.
Palisades Park, N.J.
2-146

New solenoid switches for remote control, motor driven switches, hermetically sealed switches, manually operated rotary switches, many sizes including miniature, push button switches, attenuators, potentiometers, gain sets, decade boxes, Artificial Reverberation Generator.

Tech-Master Products Co.
New York 13, N.Y.
3-112

Presenting TV designed by engineers for engineers. In wired chassis or in deluxe kits, Tech-Master produces finest custom quality receivers incorporating the very latest in design for true fidelity video with clean FM audio. Now available to the discriminating Hi-Fi enthusiast with an eye for economy. The Williamson type amplifier kits and versatile wide-range preamplifier kits, both adhering to the same standards made famous by Tech-Master in TV; only finest components used.

The Technical Materiel Corp., Mamaroneck, N.Y. 1-703 & 704
Remote Control Receiver Systems, Communications Receivers, Frequency Shift Exciters, High Stability Oscillators, Diversity Receivers, Frequency Shift Converters, Tone Keyers, & Demodulators, Rhombic & Beverage Antennae Couplers, Multiplex, Teletypewriter Regenerative Repeaters, Aircraft Crash Locator Beacons, High Speed Morse Keying & Receiving Equipment, Peak Clipping Amplifiers.

(Continued on page 238A)

Here's the COMPLETE answer to—
PACKAGING INSTRUMENTS ASSEMBLIES COMPONENTS

The 12-Page
CARGO PACKERS
Brochure
on

CLIMATE-PROOF, SHOCK-PROOF
Individually-engineered
PACKAGING

Contains complete, authoritative information on specification packing for SIGNAL CORPS, AIR FORCE, NAVY and COMMERCIAL EQUIPMENT. The Cargo Packers service includes individual attention to every order. For complete data on the all-inclusive Cargo Packers service call or write for your copy. For recommendations on a specific packaging problem, contact one of our sales engineers. Advisory consultation is invited—no obligation.

- SPECIAL PACKAGING EQUIPMENT
- EXPERTS ON MILITARY REQUIREMENTS
- ECONOMICAL ASSEMBLY LINE METHODS
- INTERPRETATION OF SPECIFICATIONS
- FULL COMPLIANCE TO EVERY DETAIL

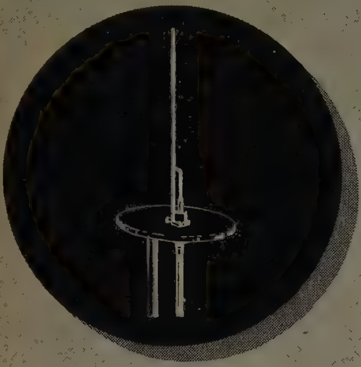
See our display at
BOOTH 4-802
on the Fourth Floor
I.R.E. SHOW!

CARGO-PACKERS
INCORPORATED
73 RUTLEDGE STREET
BROOKLYN 11, NEW YORK

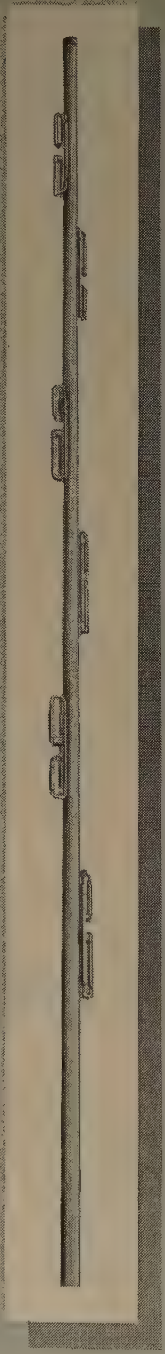
CLIMATE-PROOF PACKAGING
CARGO

ANDREW

offers a complete line of antennas for the 450-470 MC band!



The Isopole antenna, omnidirectional, rugged, inexpensive Type N input.



The High Gain antenna, omnidirectional, gain 6 DECIBELS PLUS.

The Corner Reflector antenna, 8db forward gain, broadband, horizontal or vertical polarization.

The Yagi antenna, two models with gains of 9.5 db and 12 db horizontal or vertical polarization.

Andrew CORPORATION ANTENNA SPECIALISTS
363 EAST 75TH STREET, CHICAGO 19

TRANSMISSION LINES FOR AM-FM-TV-MICROWAVE • ANTENNAS • DIRECTIONAL ANTENNA EQUIPMENT • ANTENNA TUNING UNITS • TOWER LIGHTING EQUIPMENT

What to see at the Radio Engineering Show

(Continued from page 237A)

Technitrol Engineering Co.
Philadelphia 33, Pa.
4-107

Miniature Pulse Transformers
Electric Delay Lines
Varipulser-Laboratory pulse generator
Electronic Digital Computers and Memories.

Technology Instrument Corp.
Acton, Mass., 1-111

ITC

Phase Measuring Devices, Impedance Measuring Devices, Signal Generators, Wide - Band Amplifiers, Complex Plane Analyzers, Precision Linear and Non-Linear Potentiometers, and Potentiometer Noise Analyzers will be displayed.

Tektronix, Inc.
Portland 7, Ore.
2-401, 402
The Symbol of Excellence

TEKTRONIX

In Electronic Instrumentation

Tektronix, Inc., P.O. Box 831, Portland 7, Ore. 2-401 & 402
Laboratory type Oscilloscopes, Precision type High Speed Oscilloscopes, Square and Special Wave Form Generators, Direct Coupled and Wide Band Amplifiers.

Telechrome, Inc.
Amityville, L.I., N.Y.
3-407

Color TV Generating and Monitoring equipment for all systems; also equivalent monochrome instrumentation; flying spot picture generators; fluorescent noise generators and wave guides; telecast studio electronic prompter.

Telechrome, Inc., Amityville, L.I., N.Y. 3-407
Five-rack battery of color-generating and monitoring equipment will be demonstrated in actual operation. Full color transparency slides will be employed as transmission material. Will also show two types of monochrome picture generators—one composite, one economy version.

Telechron Dept. of General Electric Co., Ashland, Mass. 1-129
Presents at the Radio Engineering Show its line of timers and synchronous timing motors. Included are timers for radios, television sets, ranges, refrigerators, washers, and many other products—also Telechron timing motors for many applications. The company offers complete application Eng. and appearance design services.

Teletronics Lab., Inc., Westbury, L.I., N.Y. 4-901
Pulse Generators, Calibrators, Diode, Test Sets, Audio Oscillators, Telemetering Test Sets, Crystal Test Sets.

(Continued on page 240A)

electronic components...

accurate to the most exacting tolerances

- **Design & Engineering Assistance**
- **Machining**
- **Assembling**
- **Testing**

Experienced in precision work with such alloys as beryllium copper, molybdenum, tantalum and Monel as well as Plexiglas and polystyrene. Approved for subcontractor defense work and cleared to handle classified matter.

Send for illustrated brochure on complete facilities.

ELECTRONIC DEVICES PRECISION PARTS
GOMBOS

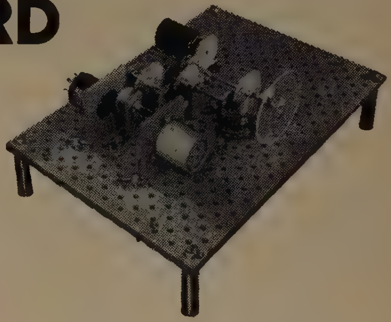
JOHN GOMBOS CO., INC.
103-109 MONTGOMERY AVE.
IRVINGTON, N. J.

SERVOSCOPE®

Test analyzer for use in development and PRODUCTION of SERVOMECHANISMS and PROCESS CONTROLS. Measures FREQUENCY RESPONSE, PHASE SHIFT 0.1 to 20 CYCLES SINE WAVE, SQUARE WAVE, MODULATED CARRIER, 50 to 800 CYCLES.

SERVOBOARD

A FLEXIBLE SET of PRECISION mechanical parts for quickly coupling motors, synchros, potentiometers to form assemblies of Servo systems, regulators, computors.



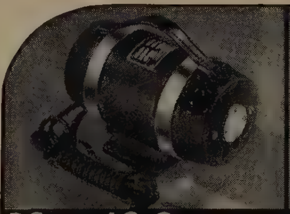
SERVO

SERVO CORPORATION OF AMERICA

IRE-3

NEW HYDE PARK, N.Y.

See Us at Booth 3-524, Radio Engineering Show, March 23-26



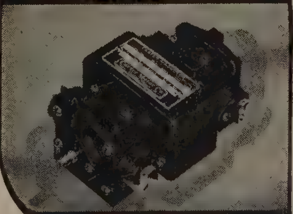
DC to AC Converters

Dynamotors

Genemotors

Recorder Converters

Inductor Alternators



Magmotors

DEPENDABLE . . . COMPACT . . . EFFICIENT

Carter Rotary Power

Carter DC to AC Converters, Dynamotors, Genemotors, Magmotors, and Inductor Alternators (inverters) are made in a wide variety of types and capacities adaptable to communications, laboratory, and industrial applications, of many kinds. Widely used in aircraft, marine, and mobile radio, geophysical instruments, laboratory work, ignition, timing and many other uses.

Carter Motor Co.
2645 N. Maplewood Ave., Chicago 47
Sales Offices in Principal Cities

MAIL COUPON FOR CATALOGS

Please send catalogs containing complete information on Carter Rotary Power Supplies.

Name____________________________________

Address____________________________________

City__________________________State__________

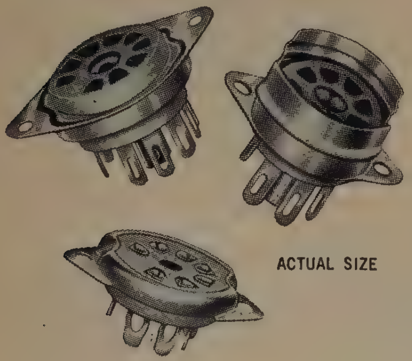
*Trade Mark Registered

ELECTRICAL INSULATION THAT WILL TAKE 2000° F. FOR BRIEF PERIODS!

Aircraft fire detection apparatus needs that. Here is the Mycalex glass-bonded mica part that has it.

Mycalex 410 molded with steel ring inserts for thermocoupling device produced by Thomas A. Edison, Inc.

● For permanent endurance Mycalex can take 650°F. continuously without heat distortion or any other injury.



Mycalex is superior for high voltage, high frequency components that must operate in small spaces.

For example, tube sockets like these — now used in over 60% of all television receiver tuners. — Manufactured and sold by Mycalex Tube Socket Corporation, Clifton, N. J.

If your insulation must take heat or get rid of heat, investigate Mycalex!

WRITE FOR ENGINEERING DATA BOOK

SINCE 1919
MYCALEX
THE INSULATOR ®

MYCALEX CORPORATION of AMERICA
Owners of "MYCALEX" Patents and Trade-Marks
Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.
GENERAL OFFICES AND PLANT
111 CLIFTON BOULEVARD, CLIFTON, N. J.

What to see at the Radio Engineering Show

(Continued from page 238A)

Television Equipment Corp., New York 4, N.Y. 3-406
Wide band-high gain general purpose oscilloscope, multi-wave form generator SYNCROPLEX, Model T-602 Projection Oscilloscope.

Tele-Tech & Electronic Industries, New York 17, N.Y. 2-215
This TV-electronic engineering magazine, published by Caldwell-Clements, Inc., is exhibited in blown-up form in a totally new display which also includes Tele-Tech supplements, maps, charts, directories, etc., on subjects such as existing microwave systems, Armed Forces procurement structure, TV special effects, etc.

Tel-Instrument Co., Inc.
East Rutherford, N.J.
2-114 & 115

A complete line of T-V Production Test Equipment. Of particular interest is the new Type 1211 UHF Sweep Generator covering the range from 430 MC to 910 MC. This instrument will be set up in a working demonstration for interested visitors. Other instruments will include a new type 2113 12 channel transmitter and a Type 1212 Sweep Generator having 13 channels.

Tensolite Insulated Wire Co., Inc.
Tarrytown, N.Y.
4-124

Miniature plastic insulated wire & cable; teflon insulated hook-up wire; flexible tone-arm lead wire; hearing aid cordage.

Thomas Electronics, Inc., Passaic, N.J. 4-220 & 221
Cathode-Ray Tubes.

Thompson Products, Inc., Cleveland 3, Ohio Theatre 3-209
Microwave component and accessory equipment, specialized test equipment which include RG-9/U, RG-17/U size Coaxial Switches; with various types of actuators; Lobing Switches; Wavemeters; antennas; and Pattern measuring range systems which are comprised of polar recorders, model support towers, bolometer-crystal amplifiers, monitor amplifiers, and high voltage power supplies.

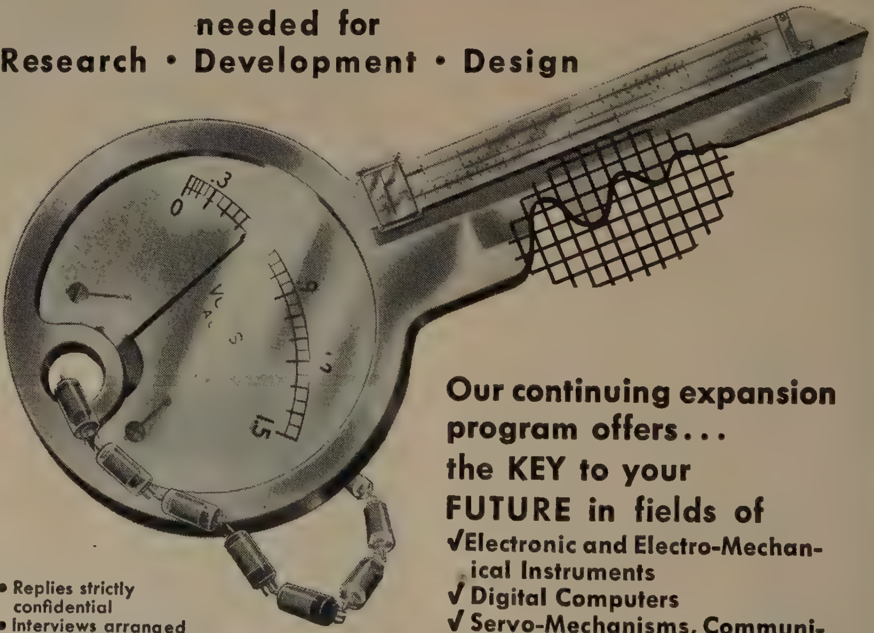
Thor
STEATITE COMPONENTS
for
ELECTRONIC and ELECTRICAL APPLICATIONS
3-409
THOR CERAMICS, INC.
BLOOMFIELD, N.J.

Thor Ceramics, Inc., Bloomfield, N.J. 3-409
A complete display of STEATITE INSULATORS including bushings, bobbins, stand-offs, machined and metallized components for electronic and electrical applications.

Tinnerman Products, Inc., Cleveland 1, Ohio 3-404 & 405
Speed nuts, speed clips, speed clamps, speed grips and engineered fasteners.

Titeflex, Inc., Newark 5, N.J. 2-308
Microwave components and the Titeflex Connector.

ENGINEERS — PHYSICISTS
needed for
Research • Development • Design



Our continuing expansion program offers...
the KEY to your FUTURE in fields of
✓Electronic and Electro-Mechanical Instruments
✓Digital Computers
✓Servo-Mechanisms, Communication and Recording Devices
✓Magnetic and Dielectric Recording

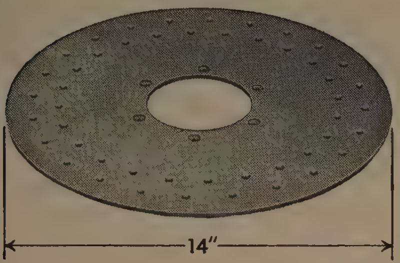
- Replies strictly confidential
- Interviews arranged at our expense
- Household goods moving expenses paid.

Engineering Research Associates
Division of Remington Rand Inc
1902 W. Minnehaha Ave. St. Paul W4, Minnesota
You will enjoy LIVING in Minnesota

ELECTRICAL INSULATION THAT CAN BE MADE TO THE SAME TOLERANCES AS STEEL

YES, we *do* mean *any* tolerances that can be produced in steel.

For example:



Two of these 14" Mycalex 400 discs revolve with only .004" clearance.

Dimensionally stable, too. Mycalex *stays* accurate.

Mycalex glass-bonded mica is found in *HIGH PRECISION* electrical components.

WRITE FOR ENGINEERING DATA BOOK

SINCE 1919
MYCALEX
THE INSULATOR ®

MYCALEX CORPORATION of AMERICA
Owners of "MYCALEX" Patents and Trade-Marks
Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.
GENERAL OFFICES AND PLANT
111 CLIFTON BOULEVARD, CLIFTON, N. J.

What to see at the Radio Engineering Show

Trad Television Corp.
Asbury Park, New Jersey
Booth 4-419

UHF and VHF step attenuators. Variable frequency power supply. UHF test equipment.

Triad Transformer Corp.
Venice, Calif.
4-602

Input, interstage, output, line matching, plate, power, auto, isolation, pulse, and 400 cycle transformers, hermetically sealed power and audio components, toroids, filters, television components, flyback transformers, yokes, vertical oscillator transformers, vertical output transformers, hermetically sealed terminals and transformer cases.

Transformer & Electronic Specialties Co., Philadelphia, Pa. 4-622
Display of Transformers and Electronic Assemblies manufactured by TRESCO. Canned Transformers Per MIL-T-27. Magnetic Amplifiers. Specialized Electronic Assemblies Canned and Potted Standard Commercial Types Transformers.

The Triplett Electrical Instrument Co., Bluffton, Ohio 2-504
Electrical Measuring Instruments and Radio-TV Test Equipment.

Truscon Steel Co.
Youngstown 1, Ohio
2-322

Radio Towers

Tung-Sol Electric, Inc.
Newark 4, New Jersey
4-715

Electron Tubes, Flashers, Miniature Lamps

George Ulanet Co.
Newark 5, N.J.
4-131

Complete line of Miniature Thermostats and Thermal Timers as well as standard line of Thermal Control Units, Immersion and Air sensitive units. Special Thermostats for all industrial requirements.

Ungar Electric Tools, Inc., Los Angeles 54, Calif. 4-303
Soldering Irons & Soldering Pencils.

(Continued on page 242A)

IS THERE ANYTHING WRONG WITH MYCALEX?

YES

It's inelastic
- But inserts won't shake loose.

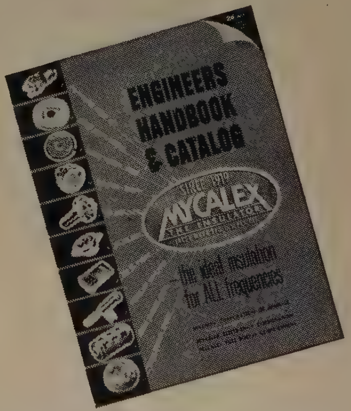
It has high density
- But permits reduction of overall size and weight.

It has no color appeal
- But has certain surface finish interest.

MYCALEX GLASS-BONDED MICA *IS THE ONLY* *CERAMOPLASTIC*

The only material combining most of the best properties of ceramics and plastics, plus some of its own.

GET THE FULL, FRANK STORY


ENGINEERS HANDBOOK & CATALOG
SINCE 1919
MYCALEX
THE INSULATOR
the ideal insulation for ALL frequencies

WRITE FOR ENGINEERING DATA BOOK

SINCE 1919
MYCALEX
THE INSULATOR ®

MYCALEX CORPORATION of AMERICA
Owners of "MYCALEX" Patents and Trade-Marks
Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.
GENERAL OFFICES AND PLANT
111 CLIFTON BOULEVARD, CLIFTON, N. J.

DON'T MISS THIS
AT THE SHOW!
See the exciting line of

REJAFIX
MARKING MACHINES

THE MOST VERSATILE MARKING EQUIPMENT IN EXISTENCE TO PRINT ON:

- RESISTORS
- VALVES
- TUBES
- CAPACITORS
- TRANSFORMERS
- RELAYS
- CONTROLS, ETC.

Booth 4-818
Radio Engineering Show—March 23-26
If you can't visit the show in person write for literature

POPPER & SONS, INC.
300 FOURTH AVE.
NEW YORK 10
OR. 4-5500

BURLINGAME ASSOCIATES
invites you to see

LABSCOPE
Precision, equal-amplifier
OSCILLOSCOPES

haledy
cold-cathode industrial
CONTROLS and COUNTERS
totalizing and preset

AT BOOTHS 2-135-136

As usual, we'll be on hand to
greet you at the booths of:

HEWLETT-PACKARD
VARIAN ASSOCIATES
BETA ELECTRIC
HYCOR
BRUSH ELECTRONICS
SORENSEN & CO.
Rutherford Electronics
GENERAL PRECISION LAB.

BURLINGAME ASSOCIATES
103 Lafayette Street • New York 13, N. Y. • Tel. Digby 9-1240
WASHINGTON PHILADELPHIA SYRACUSE BOSTON

What to see at the Radio Engineering Show

(Continued from page 241A)

Union Carbide and Carbon Corp. 1-514, 1-516, 518
SEE: Linde air & national carbon.

United Catalog Publishers, Inc., New York 13, N.Y. 3-518
Radio's Master—1220 pages—17th edition, catalogs over 80,000 electronic products with thousands of illustrations, descriptions, and specifications. Eighteen product sections and complete detailed index makes it easy to locate and compare. Radio's Master is the Industry's Official Buying Guide and Reference Book.

U. S. Gasket Co.
Camden, N.J.
3-103

9-pin transformer terminal, subminiature teflon tube sockets, 7- and 9-pin miniature tube sockets, crystal sockets, teflon insulators, and teflon covered wire.

United Transformer Co.
New York 13, N.Y.
1-132

Transformers, Audio, Power, Filters, Magnetic Amplifiers, High Pass, Band Pass, Low Pass Filters, Pulse Transformers, Audio, Power, Filters, tary and Aircraft Transformers.

Universal Aviation Equipment, Inc.
New York 13, N.Y.
4-416

UNIVERSAL

Illuminated control panels, dials and switchboard assemblies. Testing equipment for organic coatings.

University Loudspeakers, Inc., White Plains, N.Y. 3-311
Commercial, Industrial, High Fidelity, and Military loudspeakers. The new Cobreflex-2 wide angle horn, ideal for commercial and high fidelity applications will be introduced.

Vacuum Electronic Eng. Co., New Hyde Park, L.I., N.Y. Booth 4-404
Manufacture Veeco Mass Spectrometer Leak Detector: unexcelled for testing electronic tubes and hermetically sealed equipment. Test tables and manifold for use with leak detectors. High vacuum valves and valve manifolds. Special vacuum equipment such as evaporators, desiccators, impregnators, etc. Couplings, leaks and other vacuum accessories.

Vacuum Metals Corp., Cambridge, Mass. 1-705
Vacuum-cast, high purity, gas-free metals for magnetrons, klystrons, and hydrogen thyratrons.

VARIAN associates
KLYSTRONS
BOOTH 1-617

What to see at the Radio Engineering Show

(Continued from page 242A)

Varian Associates, San Carlos, Calif. 1-617
New production-series klystrons for x-band radar. Advanced nuclear induction instrumetation. 15 kw UHF TV amplifier klystron. Relay, beacon and missile klystrons. The new x-band radar tubes feature extreme ruggedness and frequency stability unaffected by ambient pressure. Leads are molded in silicone rubber for high-altitude and high-humidity protection.

Vector Electronic Co., Los Angeles 65, Calif. 3-515
Tube Sockets, Plugs, Adapters.

Microwave Spectrum Analyzer on display in

BOOTH 3-411

VECTRON, inc.
Electronic and Electro-Mechanical Equipment
402 MAIN STREET, WALTHAM 54, MASS.

EVERYONE KNOWS . . .

Better Components make Better Instruments.

Victoreen Instrument Co.
Cleveland 3, Ohio
4-103, 104

(Continued on page 244A)

The following 1952 Exhibitors gave up their space in the interests of MANUFACTURERS who otherwise could not exhibit

• • •

Arrow Electronics

H. L. Dalis

Harrison Radio Co.

Sun Radio and Electronics Co.

Terminal Radio Co.

Measurement of

✓**Impedance**
✓**Inductance**
✓**Capacitance**
✓**Resistance**
✓**Dissipation Factor (D)**
✓**Storage Coefficient (Q)**
✓**Plot Impedance Functions**

310A Z-Angle Meter

The type 310A Z-Angle Meter measures impedance directly in polar coordinates as an impedance magnitude in ohms and phase angle in degrees: $Z\angle\theta$

Impedance Range: .5 to 100,000 ohms, covered by a single dial and a four position range switch.

Accuracy: ± 1%

Frequency Range: 30 cycles to 20 kc. for impedances below 5000 ohms, measurements can be made up to 40 kc. For frequencies from 100 kc. to 2 mc., write for specifications for the type 311A-RF Z-Angle Meter.

Phase Angle Range: 0° to 90° Direct reading on panel meter. Meter is also Calibrated in D and Q.

Phase Angle Accuracy: Within 2° of meter indication.

Internal Oscillator: 60 cycles and 400 cycles. Terminals are provided for an external, variable frequency signal generator for measurements at other frequencies.

In the field, the laboratory, the production test floor or the class room, the extreme accuracy and the simplicity of operation has proved the type 310A Z-Angle Meter to be a superb and reliable instrument.

Write now for more detailed information.

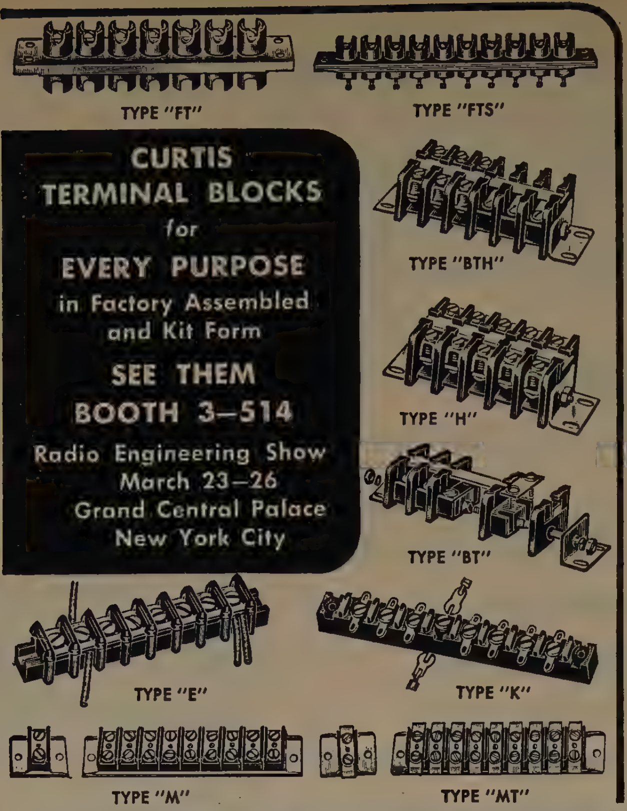
See Us in Booth 1-111
at the Radio Engineering Show

ENGINEERING REPRESENTATIVES

Chicago, Ill. — UPtown 8-1141
Cleveland, Ohio — PRospect 1-6171
Waltham, Mass. — WAltham 5-6900
Boonton, N. J. — Boonton 8-3097
Dayton, Ohio — Michigan-8721
Arnprior, Ont., Can. — Arnprior 400
Hollywood, Cal. — HOllywood 9-6305
Dallas, Texas — DIxon 9918
Roseland, New Jersey — Caldwell 6-4545
Wyncote, Pa. — Ogontz 8805
Silver Spring, Md. — Sligo 7-550

TECHNOLOGY INSTRUMENT CORP.

535 Main Street · Acton, Massachusetts · Tel. ACton 3-7711

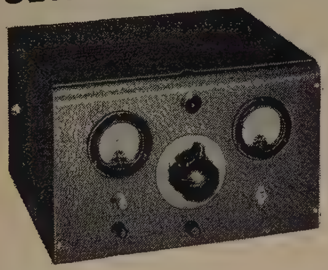


CURTIS TERMINAL BLOCKS for EVERY PURPOSE in Factory Assembled and Kit Form

SEE THEM BOOTH 3–514

Radio Engineering Show
March 23–26
Grand Central Palace
New York City

CURTIS DEVELOPMENT & MFG. CO.
3234 North 33rd Street, Milwaukee 16, Wisconsin



MULTI-USE SELENIUM POWER SUPPLY!

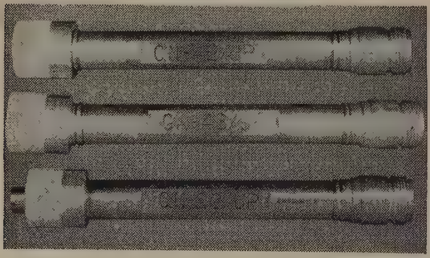
This rugged, versatile Power Supply is designed to deliver VARIABLE low voltages at high current for long periods. Ideal for: Engineering, Research and Development; Plating; and Bench Testing (aircraft radio transmitters, dynamotors, etc.).

- Single-knob, *stepless* output, 0 to 28 V. D-C; 10 A. continuous.
- Full-wave Bridge Rectifier.

MODEL 1028 (unfiltered)

▶ POWER SUPPLIES BUILT TO YOUR SPECIFICATIONS

INDUSTRIAL RECTIFIER COMPANY
161 Washington Street
New York 6, New York
Phone: Digby 9-3832



MICROWAVE TEST EQUIPMENT

ATTENUATORS

Tested and Manufactured to Air Force Specifications.

Designed and Manufactured to Special Frequencies and Attenuations.

AT 67/AP. Horn Type Microwave Antenna S Band
TS 125/AP. Power (Watt) Meter S Band
TBN 3 EV. RF Bridge K-S-X Band
Thermistor Mounts & Ovens
Other Microwave Test Equipment

Complete Information Furnished on Request

ELECTRON-RADAR PRODUCTS
1041 N. Pulaski Road
Chicago 51, Ill.
Phone. Dickens 2-5885

What to see at the Radio Engineering Show

(Continued from page 243A)

Victoreen Instrument Co., Cleveland 3, Ohio 4-103 & 104
An expanding group of miniaturized components will be displayed to include: Voltage regulators 50 to 15,000 V, new current regulators, new glass sealed resistors 800 Ohms to 10 Megs., vibrators and vibrator power supplies, subminiature electrometer and special purpose tubes, counter tubes, radiation measuring instruments, accelerometers.

Victory ENGINEERING CORPORATION
Springfield Road • Union, New Jersey
Telephone UNionville 2-7150

3-403

See Thermistors in action! Amplitude control. Time delay. Voltage regulation. Oscillator Stabilization. Surge protection. Air flow measurement. Combustion analyzer. Gas analysis cells. See the actual production of Veco Thermistor Beads, the smallest mass-produced electronic item! Ask for the Veco Data Book.

Vitramon, Inc., Bridgeport 1, Conn. 3-516
Vitramon Capacitors, low-loss, high stability, and wide temperature range.

Waldes Kohinoor, Inc., Long Island City 1, N.Y. 2-127
Truarc Retaining Rings.

Wang Laboratories, Boston 16, Mass. 4-803
Static Magnetic Memory Units and Systems; Shift Register Systems; Digital Signal Generator—A Versatile Instrument for Testing Computers and Data Processing Equipments; Character Display Signal Generator—The Fastest Available Output Device; Pulse Count Converter; Magnetic Constant Charge Device; Frequency Meter; Perma-Memory Multiple Scalers.

Ward Leonard Electric Co., Mt. Vernon, N.Y. 3-113
Vitrohm Resistors in 7 stock types and 11 Made-to Order styles, High current resistors, Load banks, Vitrohm Ring and Plate type Rheostats, A.C. and D.C. Relays, Magnetic Contractors, Motor starters, Controllers, Theatre Dimmers, Chromaster industrial chrome plater.

Waterman Products Co., Inc.
Philadelphia 25, Pa.

1-414

In the field of electronic research and development, Waterman Products is leading the way. The HIGH, WIDE and TWIN Pocketscopes have become the "triple threat" of the oscilloscope industry. Waterman pioneering has brought forth revolutionary rayonic cathode-ray tubes for miniaturized oscilloscopes and continues to lead the way in electronic development.

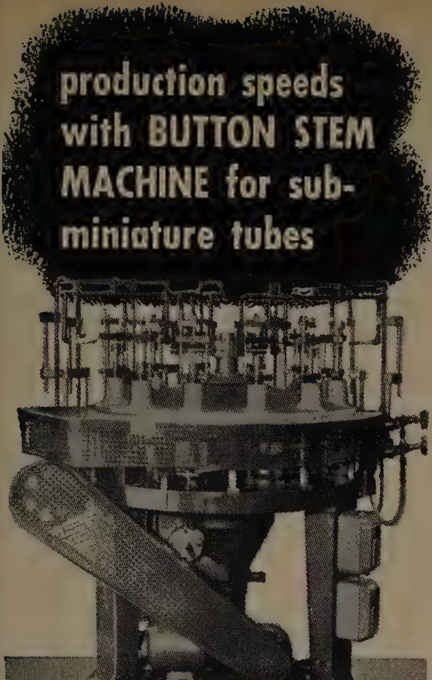
Waveforms, Inc., New York 14, N.Y. 3-313
Miniature Precision Instruments: Extended-Range Audio Oscillator (18 cycles to 1.2 megacycles; less than 0.2% distortion); Sensitive Voltmeter (1 millivolt full scale; 10 cps to 2 mc); Precision Crystal Calibrator with heterodyne mixer; Audio Curve Tracer (visual display). High Quality Audio Amplifiers and Preamplifier-control Units: Laboratory Instruments: AM-FM Signal Generator (100 kc.-170 mc).

W. M. Welch Scientific Co., Chicago 10, Ill. 2-137
Duo-seal vacuum pumps, capable of .05 micron and better. New totally enclosed belt guards. Dubrovin vacuum gauges and other vacuum accessories.

Western Lithograph Co., Los Angeles, Calif. 1-105
E-Z Code wire identification markers. N.E.M.A. color code markers. TEL-A-PIPE cable, conduit, and pipe markers, Westline contact labels, Breakaway labels hundreds of stock items to solve your coding problems and identification easily and inexpensively.

Visit all four floors!

(Continued on page 246A)


production speeds with BUTTON STEM MACHINE for sub-miniature tubes

Leading manufacturers of sub-miniature tubes were frantically re-vamping their old machines to avoid production tie-ups in making glass buttons with lead wires. These machines did not meet the exacting requirements of sub-miniature tube production.

Shown above is Kahle's new model 427 Button Stem Machine designed for T2, T3 and T2 x 3 sub-miniature button stems. This is a 12 head machine, with upper and lower moulds on every lead; dual-motor drive — indexing and head are driven by separate motors — indexing by barrel cam and rollers (hardened and ground) totally enclosed in oil. This machine can be made available for any stems, — with any number of heads, — with automatic feeds.

But this is the solution to only one of many problems which Kahle engineers have been asked to solve over the past 40 years. If you have any difficulty which can be overcome with custom-designed machinery,

write today and learn—without obligation—how Kahle's experience can benefit you.

Kahle

ENGINEERING COMPANY

1312 SEVENTH STREET
NORTH BERGEN N. J.

FM/AM SIGNAL GENERATOR TF 995

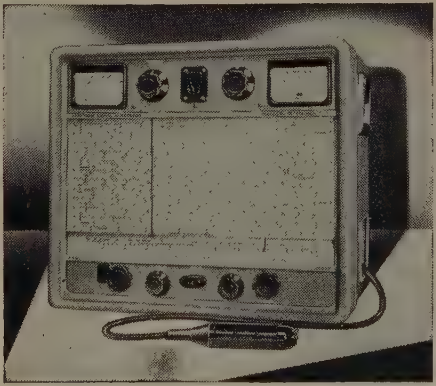
A crystal standardized generator either frequency or amplitude modulated. Frequency range: 13.5 to 216 megacycles. Output range 0.1 microvolts to 100 millivolts. Internal or external modulation gives f.m. deviations to 600 kilocycles and a.m. depths to 50 per cent.

UNIVERSAL BRIDGE TF 868

Measures inductance and capacitance at 1,000 cycles, resistance at d.c.; direct reading 1 microhenry to 100 henries, 1 micro-microfarad to 100 microfarads, and 0.1 ohms to 10 megohms. Q range 0.1 to 1.000, tanδ 0.001 to 10.

FM DEVIATION METER TF 934

With crystal-standardized deviation ranges of 5, 25 and 75 kilocycles, alternative high- and low-level buffered inlets, visual checking for optimum tuning and level, together with a separately buffered audio outlet, this ruggedized deviation meter is ideal for carriers in the range 2.5 to 200 megacycles.



STANDARD SIGNAL GENERATOR TF 867

For precision receiver measurements: Covers on an expanded full-vision scale 15 kilocycles (or less) to 30 megacycles, crystal standardized, with an output continuously variable from 4 volts to 0.4 microvolts. Up to 100 per cent. a.m., with unmeasurable f.m., monitored by dual rectification.

We shall be pleased to see you at the I.R.E. Convention BOOTH 1-520

MARCONI INSTRUMENTS

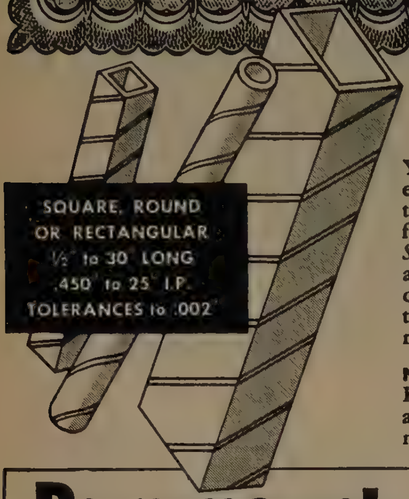
VACUUM TUBE VOLTMETERS • FREQUENCY STANDARDS • OUTPUT METERS
WAVE METERS • WAVE ANALYSERS • Q METERS • BEAT FREQUENCY OSCILLATORS

23-25 BEAVER STREET • NEW YORK 4

CANADA: CANADIAN MARCONI CO., MARCONI BUILDING, 2442 TRENTON AVENUE, MONTREAL
ENGLAND: Head Office: MARCONI INSTRUMENTS LIMITED, ST. ALBANS, HERTFORDSHIRE
Managing Agents in Export:
MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, MARCONI HOUSE, STRAND LONDON, W.C.2

Coil Insurance

FOR FAMOUS PRODUCTS



PARAMOUNT Spiral Wound PAPER TUBES
Protect Coil Accuracy and Stability in Countless Applications

Years of specialized "know-how" easily enable PARAMOUNT to provide exactly the shape and size tubes you need for coil forms and other uses. *Hi-Dielectric. Hi-Strength.* Kraft, Fish Paper, Red Rope or any combination wound on automatic machines. Wide range of stock arbors. Special tubes made to your specifications or engineered for you.

NEW! Moisture-Resistant *Shellac-Boun* Kraft Paper Tubing. Heated shellac forms a bond which prevents delaminating under moisture conditions.

Paramount PAPER TUBE CORP.
617 LAFAYETTE ST., FORT WAYNE, IND.
Mfrs. of Paper Tubing for the Electrical Industry Since 1931

WRITE ON COMPANY LETTERHEAD FOR STOCK ARBOR LIST OF OVER 1000 SIZES

NOISE METER • Model NF-114

(Commercial Equivalent of AN/PRM-14)

Engineering Data

- Frequency range 0.15 MC to 80 MC in 8 bands.
- Two tuned RF amplifier stages are employed throughout for high sensitivity and optimum rejection of spurious responses.
- Built-in impulse noise calibrator flat to 100 MC.
- Meter indication of carrier or true peak voltage.
- Aural slide-back operation.
- Dry battery or AC (regulated "A" and "B") operation.
- Subminiaturized construction.
- Complete line of accessories available.

Visit our Booth No. 2-147 at the IRE Show.

EMPIRE DEVICES, INC. 38-25 BELL BOULEVARD, BAYSIDE 61, N. Y.

MANUFACTURERS OF
FIELD INTENSITY METERS • DISTORTION ANALYZERS • IMPULSE GENERATORS • COAXIAL ATTENUATORS • CRYSTAL MIXERS

What to see at the Radio Engineering Show

(Continued from page 244A)

Westinghouse Electric Corp., Pittsburgh 30, Pa. 1-610, 612, 614, 616 & 618
Westinghouse will feature Electrical tubes; speciality transformers; hipersil cores; magamps; electrical instruments; circuit breakers; motor starters; thermostats; and fire control demonstration.

Westinghouse Electric Corp., Bloomfield, N.J. 1-610, 612, 614, 616 & 618
Electronic Equipment Components.

Weston Electrical Instrument Corp.
Newark 5, N.J.
4-409 & 411
Service Instruments for Television and Radio—Panel Instruments for electronic equipment—Approved Ruggedized Instruments—Sensitive Relays—New Sealed Relay with core magnet mechanism and built-in solenoid device—D-C Amplifier—Contact Making Instrument—Portable A-C and D-C Instruments.

White Industries, Inc.
New York 19, N.Y.
3-304B
Noise Amplifiers, Pre-Amplifiers, Phase Adapters, Wire Recording Amplifiers and Drive Mechanism, Control Boxes, Noise Measuring Probes, Noise Measuring Antennas, High Fidelity Amplifiers and Preamplifier, Radio Receivers and Transmitters, Transformers, Variable Capacitors, Special Electronic Assemblies, Telemetering Equipment, Tools and Dies, Precision Machine Parts, Electro-Mechanical Development & Engineering, Drafting, Schematics.

Whitso, Inc., 9328 Byron St., Schiller Park, Ill. 4-721
Plastic standoff terminals. New metal hex sub-miniature in addition to large selection of conventional fork and turret types with stud, female, rivet mountings inquiries are invited as to special problems and materials.

Wilkor Div., Cleveland 13, Ohio 1-602
SEE Aerovox Corp.

Wind Turbine Co., West Chester, Pa. 1-508
TRYLON Ladder Towers.

The Workshop Associates, Div. Gabriel Co., Needham Heights 94, Mass. 1-513
UHF-TV Transmitting antennas plus a complete line of Microwave Relay Antennas.

(Continued on page 267A)

The following 1952 Exhibitors gave up their space in the interest of MANUFACTURERS who otherwise could not exhibit

• • •

Arrow Electronics
H. L. Dalis
Harrison Radio Co.
Sun Radio and Electronics Co.
Terminal Radio Co.

TUBES

Here's your opportunity to buy receiving and special purpose tubes for: Industry, Communications, Research, Defense

Real values that will save you

10 to 70%

State types and quantities for additional discounts. Call or write today for special price list.
We are world wide suppliers to airlines, government agencies and the radio industry. For cooperation and reliable service we invite your inquiries.

SPECIAL

TYPE 805

LIST $13.50
OUR PRICE **$3.50**

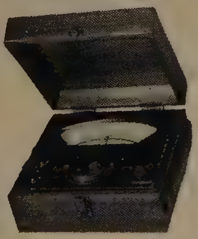
We are ready to buy for cash radio tubes; state quantity and price in first letter. WHAT HAVE YOU?

ATTENTION MANUFACTURERS

Are you interested in building up your export sales? Let us handle your line at no cost to you. We are experienced in such transactions and our active agents overseas are constantly in touch with potential buyers. We handle non conflicting exclusive lines only: Why not earn additional dollars? Contact Michael Levit

METROPOLITAN OVERSEAS SUPPLY CORPORATION
1133 BROADWAY
Tel CHelsea 3-1105 New York 10, N.Y.
Cable Address "LECIMEX" New York

TEST YOUR MAGNETIC CIRCUITS



RAWSON FLUXMETER
TYPE 504

The only portable fluxmeter available which returns rapidly to zero when a single button is depressed. Simple and fast in operation. Convenient and light in weight.

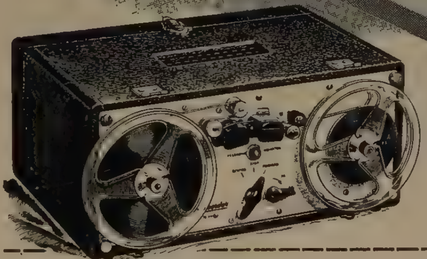
Not limited to a single type of measurement. Has universal application for laboratories or production. Measures strength of magnets and electromagnets, permeability and hysteresis loops for iron and steel, total flux lines in circuit, flux lines developed in air gap, etc.

Has a mechanical clamp to protect the pivots and jewels when in transit.

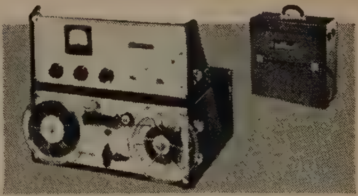
RAWSON ELECTRICAL INSTRUMENT COMPANY
118 POTTER STREET, CAMBRIDGE 42, MASS.
Representatives
CHICAGO LOS ANGELES

THERE'S A magnecorder FOR EVERY Communications Monitoring NEED

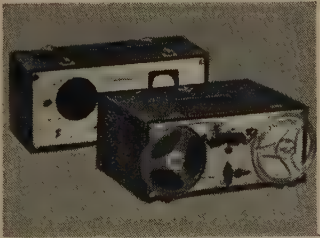
1-, 2-, and now 4-channel Magnecorder



ONE-CHANNEL MAGNECORDER—long accepted as the standard professional tape recorder in the communications and broadcast fields. Conversion kits quickly adapt your equipment for all special purposes.



ONE-CHANNEL PORTABLE—the new VOYAGER, a one-case truly portable recorder of professional quality. A standard PT6-AH Magnecorder is mounted back-to-back with line level amplifier which swings forward for instant use. Unsurpassed for remotes or field tests. Lightweight, rugged, reliable.



TWO CHANNELS—The acclaimed new Binaural Magnecorder provides either two-channel monitoring or brilliantly realistic 3-dimensional sound on one tape. Two simultaneous tracks accurately reproduce separate sounds or can provide stereo depth and direction, permitting one sound to be identified among many. The versatile dual channels can also be used for separate two-channel communications monitoring.

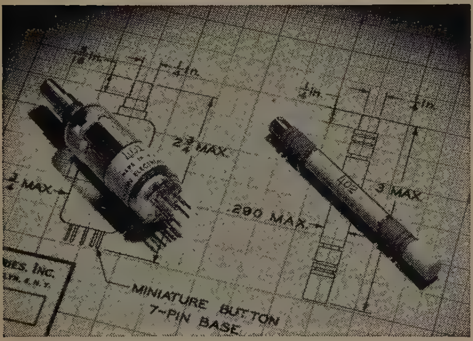
FOUR CHANNELS—The first *automatic* continuous recorder that monitors up to four channels at once on a standard ¼" tape. Originally engineered and JANized for the CAA, it is adaptable for utilities and carriers, fire and police calls, airports and civil defense.

Visit us at the I. R. E. Show Audio-Theatres, 301-303.

Magnecord INC.
225 West Ohio Street, Dept. P-3 · Chicago 10, Illinois

Your "Regulated High Voltage" Problems can be Economically Solved . . . NOW!

ANTON



You will see Anton V-R Tubes in operation at Booth 4-108 . . . IRE Show

JAN APPROVED

AEL has produced and supplied over 100,000 JAN 5962/BS-101 Corona Discharge Voltage Regulator Tubes (equivalent to 401 shown here) to the U. S. Navy—Signal Corps and prime contractors like Admiral, Westinghouse, Kelly-Koett and Hoffman. Because of the experience gained by the mass manufacture of these tubes, AEL is able—now—to furnish Corona Discharge V-R Tubes, both fixed and variable, to suit a wide range of voltage and current applications.

Corona Discharge V-R Tubes

New Freedom for Circuit Designers

SALIENT FEATURES

- Stabilized Voltages from 300 to 4000 Volts
- Currents up to 2 milliamperes
- Low Dynamic Resistance
- No hot cathodes
- Unlimited Life
- Weight—less than an ounce
- Size—smaller than a pen

TYPICAL APPLICATIONS

- Cathode Ray Oscilloscopes
- Airborne Radar Power Supplies
- TV receivers and monitors
- Voltage Reference Tubes
- Meter Safeguards
- X-ray Equipment
- Electron Microscopes

CATALOG—free upon request on your letter-head. Please send us the specifications of your individual requirements. Write care of Dept. I.

ANTON ELECTRONIC LABORATORIES, INC.

1226 Flushing Avenue, Brooklyn 37, N. Y.

STUDENT BRANCH MEETINGS

BUCKNELL UNIVERSITY, IRE-AIEE BRANCH

"Instrumentation" by Mr. Daniels of Minneapolis Honeywell and "Professional Engineering" by Mr. John West, Sec. Professional Engineering Society Pa.; January 14, 1953.

UNIVERSITY OF CALIFORNIA, IRE-AIEE BRANCH

"Electromedical Applications" by R. S. Mackay, Faculty, University of California; December 2, 1952.

Nominations Meeting; December 15, 1952.

CALIFORNIA STATE POLYTECHNIC COLLEGE, IRE BRANCH

"Engineering and Research Management" by Myrl Stearns, Executive Vice Pres. and General Manager of Varian Associates; December 4, 1952.

UNIVERSITY OF COLORADO, IRE-AIEE BRANCH

"Recent Developments in Public Utilities" by Mr. W. Pullen, Engineer for General Electric Co.; November 19, 1952.

"What is Ahead for the Engineer" by Mr. E. S. Lee, Engr. for General Electric; December 3, 1952.

Short talks were given by several senior students; December 17, 1952.

THE COOPER UNION SCHOOL OF ENGINEERING, IRE-AIEE BRANCH

"Theory of Magnetic Amplifiers" by Mr. I. Kaelish, Student, Cooper Union; December 22, 1952.

UNIVERSITY OF DAYTON, IRE BRANCH

"Radar Traffic Speed Controller & Municipal Communications Systems" by Mr. Martin Schultz & Mr. Robert Baker, Municipal Signal Division, Dayton, Ohio; November 4, 1952.

"An Executive's Views on Important Points of an Education" by Dr. J. W. Ballard, Head of E.E. Dept., Commonwealth Engineering Co., Dayton, Ohio; November 18, 1952.

"The Electronic Switch" by J. L. Nelson, Student, Dayton Univ.; January 6, 1953.

UNIVERSITY OF DETROIT, IRE-AIEE BRANCH

"Electrical Controls in the Production of Automobiles" by Bernie Meldrum & J. Strakey, Electrical Engineering Dept., Desoto; December 17, 1952.

FENN COLLEGE, IRE BRANCH

"Saturable Iron Core Reactors and Magnetic Amplifiers" by Mr. H. M. Huge, V.P. and Chief Engineer of Lorain Products Corp., Lorain, Ohio; December 17, 1952.

ILLINOIS INSTITUTE OF TECHNOLOGY, IRE BRANCH

Nomination of Officers; January 20, 1953.

LEHIGH UNIVERSITY, IRE BRANCH

"The IBM Card-Programmed Electronic Calculator," by Donald J. Glick, Former Mathematician at IBM Vestal Laboratory and General Meeting; December 11, 1952.

UNIVERSITY OF MAINE, IRE BRANCH

"Opportunities with the National Bureau of Standards" by Mr. Frederick Mitchell, Representative of the National Bureau of Standards; January 14, 1953.

(Continued on page 250A)

ATR

AUTO RADIO
VIBRATORS
*have Ceramic
Stack Spacers*

A COMPLETE LINE
OF VIBRATORS . . .

Designed for Use in Standard Vibrator-Operated Auto Radio Receivers. Built with Precision Construction, featuring Ceramic Stack Spacers for Longer Lasting Life. Backed by more than 17 years of experience in Vibrator Design, Development, and Manufacturing.

ATR
✓ NEW MODELS
✓ NEW DESIGNS
✓ NEW LITERATURE

"A" Battery Eliminator A-C D-C Inverters
Auto Radio Vibrators
See your jobber or write factory

AMERICAN TELEVISION & RADIO CO.
Quality Products Since 1931
SAINT PAUL 1, MINNESOTA—U. S. A.

MICAMOLD
presents

Microlytic®

the smallest
electrolytic
capacitor

Microlytic capacitors
are available
in production quantities

Address your inquiries to Dept. R1

Micamold

MICAMOLD RADIO CORPORATION
1087 FLUSHING AVENUE, BROOKLYN 37, N. Y.

MANUFACTURERS OF MICA • PAPER • ELECTROLYTIC CAPACITORS • RADIO INTERFERENCE FILTERS *another* **PREMIER**

Precision-built **METAL HOUSING**

LOOSE JOINT HINGES ON BOTH DOORS
BLACK OR GREY WRINKLE
COMPLETELY WELDED THROUGH-OUT
16 GAUGE SHEET STEEL
RED STRIPED CHROME MOULDING Top and Bottom
CHROME SNAP CATCHES
HANDLE AND LOCK
TAPPED 12/24 ON UNIVERSAL SPACINGS
3/16 THICK MOUNTING ANGLES
WITH OR WITHOUT LOUVRES
CUT-OUT FOR LEADS, ETC.
BOTTOM 12 GAUGE STEEL
DUPLEX RECEPTACLE AND OUTLET BOX
RACKS
CABINETS
CHASSIS
PANELS

TRANSMITTER RACKS
2 PANEL SPACES AVAILABLE
61¼" and 77"

PREMIER METAL PRODUCTS COMPANY • 3160 WEBSTER AVE., BRONX 67, N.Y.

SEE OUR DISPLAY AT YOUR LOCAL Distributor

SEND FOR COMPLETE CATALOG

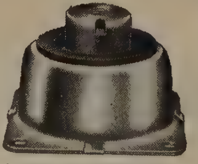
VISIT OUR BOOTH No. 4-509 I.R.E. SHOW Grand Central Palace, N. Y. C. Mar. 23-24 25-26

FINNFLEX **AIRBORNE MOUNTING BASES**

Conform to JAN-C-172A SPECIFICATIONS ... but are actually made to *exceed* AN-E-19 Drop Test requirements

RUGGED PROTECTION for VITAL EQUIPMENT: Finnflex Mounts isolate vibration and shock from *Electronic, Communication,* and *Control Equipment.* They offer unimpaired efficiency from –80° to +250°F., *"Selective Action"* friction dampening, non-linear steel springs, and other features. Wide range of sizes and load ratings available.

TYPE SR MOUNTING BASE


TYPE TPM VIBRATION ISOLATOR

VIBRATION ISOLATORS and **SHOCK MOUNTS** To JAN-C-172A SPECIFICATIONS and TO ORDER

SHOCK MOUNTS for Signal Corps Mobile Equipment and for Naval Fire Control Units.

SPECIAL PROBLEMS: Complete facilities for designing and fabricating Shock and Vibration Mounts to order — *regardless* of size or weight of equipment mounted.

Specify FINNFLEX—for Ruggedness, Efficiency, and Economy.

Write for Catalog MB-110

T. R. FINN & COMPANY, Inc.
Specialists in Vibration Control
333 JACKSON AVENUE, NEW YORK 54, N. Y.
Phone: CYpress 2-4192-3-4

Visit us in Booth #4-611 at the IRE Show

STUDENT BRANCH MEETINGS

(Continued from page 248A)

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, IRE-AIEE BRANCH

"Latest Developments in the Audio Field" by H. H. Scott, Scott Audio Amp. Co.; December 18, 1952.

"Latest Developments in F.M." by Professor L. B. Argiumbau, Faculty, M.I.T.

MICHIGAN COLLEGE OF MINING AND TECHNOLOGY, IRE-AIEE BRANCH

"Walls Without Welds" Film, U. S. Steel and General Meeting; December 16, 1952.

MISSISSIPPI STATE COLLEGE, IRE BRANCH

"Interoffice Communication" by N. J. Lemberius, Kellog Switchboard Supply Co.; January 8, 1953.

UNIVERSITY OF MISSOURI, IRE-AIEE BRANCH

"Career Seminar Panel Discussion" by H. E. Gove, Union Electric; R. H. Baxter, Bell Telephone Labs; H. D. Sanborn, General Electric; January 13, 1953.

NEW YORK UNIVERSITY (DAY DIVISION) IRE BRANCH

Business Meeting; October 2, 1952.

Film, "Energy in our Business" by Westinghouse; October 9, 1952.

Business Meeting; October 16, 1952.

"Feedback Control Systems" by Prof. C. F. Rehberg, Faculty N.Y.U.; October 23, 1952.

"Lightning Phenomena & Protection Methods" by Mr. D. W. Bodle, Bell Telephone Labs; October 30, 1952.

Business Meeting; November 6, 1952.

Films, "Rocket Instrumentation" and "R. F. Induction Heating"; November 13, 1952.

Film, "Proving Grounds" by Westinghouse; November 20, 1952.

"Transistors & Semiconductors" by Messrs. Kirtcher & Grossman, Bell Telephone Labs; November 21, 1952.

Film, "Electronics"; December 4, 1952.

"Microwave Techniques" by Mr. Dominco, Griffis Air Base; December 8, 1952.

Films, "Submarine Cable" and "Distribution System"; December 11, 1952.

Film, "Paper-impregnated Cable"; December 18, 1952.

Film, "Circuit Breakers" and "Commutation in d-c machines" by Westinghouse; January 8, 1953.

NORTHEASTERN UNIVERSITY, IRE-AIEE BRANCH (DIV. B)

"Transistors" by Mr. George Harford, New England Telephone & Telegraph Co.; December 11, 1952.

"Servo Mechanisms" by C. D. Burdick, Sperry Gyroscope Company; December 18, 1952.

"The Electron" (motion picture); December 23, 1952.

"Films," "Radar Equipment," "Synchro Systems," "The Jet Story," General Electric and U. S. Navy Public Information Office, Boston, Mass.; December 30, 1952.

"Electric Power Engineering" by Professor Chester Dawes, Prof. Electrical Engineering, Harvard University" January 8, 1953.

OHIO STATE UNIVERSITY, IRE-AIEE BRANCH

"Installation of an Underground Transmission Line" by Mr. Campbell, Columbus & Southern Ohio Electric Co.; December 4, 1952.

"Advantages & Disadvantages of Big and Small Business" by 4 representatives of Columbus Industries; January 13, 1953.

STUDENT BRANCH MEETINGS

OREGON STATE COLLEGE, IRE BRANCH

"Some American Rivers and Their Utilization" by Dr. C. A. Mockmore, Faculty, Oregon State College; November 13, 1952.

"Germanium The Magic Metal" (A tape recorded program with 75 slides); January 8, 1953.

UNIVERSITY OF PITTSBURGH, IRE BRANCH

"Uses of Electronics in Research" by Mr. A. Peterson, Mellon Institute; December 18, 1952.

RUTGERS UNIVERSITY, IRE-AIEE BRANCH

"Generation, Transmission and Distribution of Power" by H. W. Phillips '24, Philadelphia Electric Co., John Betz '37, Public Service Gas & Electric Co. and Rodney P. Gibson '28, Public Service Generation Co.; December 18, 1952.

SAN DIEGO STATE COLLEGE, IRE BRANCH

Film, "Air Navigation" by Collins Radio Company; January 13, 1953.

"Aspects of Printed Circuits, their Design, Production and Uses" by Mr. McDonald, Digital Controls Systems, Inc. of La Jolla; January 15, 1953.

SOUTH DAKOTA SCHOOL OF MINES AND TECHNOLOGY, IRE BRANCH

General Business Meeting and Films, "Radio Waves" and "Radio Antennas"; December 18, 1952.

Film, "Walls without Welds" by U. S. Steel; January 8, 1953.

UNIVERSITY OF TEXAS, IRE-AIEE BRANCH

"Realism in Reproduced Sound" Discussion of student paper contest; December 15, 1952.

Election of Officers; January 12, 1953.

TUFTS COLLEGE, IRE-AIEE BRANCH

"Applications of Engineering in Industry" by Mr. Fred Snider, Westinghouse Electric Corp.; January 13, 1953.

UNIVERSITY OF UTAH, IRE-AIEE BRANCH

Films on Electric Measuring Instruments by Philip Weinberg and Charles Alley, Advisers; January 8, 1953.

UNIVERSITY OF WASHINGTON, IRE-AIEE BRANCH

Film, "Construction of McNary Dam" by the Corps of Engineers; November 6, 1952.

General Meeting; November 13, 1952.

Field Trip to the Pacific Telephone & Telegraph Co., Seattle; November 15, 1952.

"Germanium the Magic Metal" (a transcribed lecture with slides) by the General Electric Co., November 28, 1952.

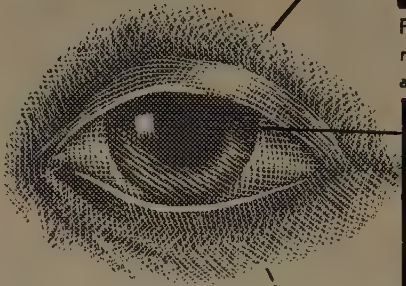
WAYNE UNIVERSITY, IRE-AIEE BRANCH

"A Panel Discussion of Curriculum" by Mr. C. S. Lawrence, Pres. Electronic Control Co., Melvin Cole, Pres. EE Wayne Alumni Assoc., Howard Hess, Head of EE Dept. at Wayne and Dr. Schoonover, Ass't Dean and Election of Officers; December 11, 1952.

YALE UNIVERSITY, IRE-AIEE BRANCH

"Digital Computers" by J. Presper Eckert, Director of Engineering, Remington-Rand Corp.; January 8, 1953.

SEE



JERROLD
MASTER ANTENNA SYSTEMS

FOR communities, hotels, apartment buildings, motels, institutions, department stores, TV dealers and Industrial application.

JERROLD
TEST EQUIPMENT

FOR industrial laboratories, engineers, technicians, TV dealers, service departments, service men and government.

The latest developments by the World's Largest Manufacturer of Amplified Master Antenna Systems at the

I.R.E. SHOW
BOOTH 4-618

JERROLD
ELECTRONICS CORP.

For further information write — 1452 SOUTH 26th STREET • PHILA, PA.

FREE! Over $1,000.00 Prizes will be distributed to 88 lucky people who visit our new home during the month of March.

Sun Radio ANNOUNCES
Grand Opening New York's Largest Electronic Center
650 Sixth Avenue, Cor. 20th St.

★ Central location for all Metropolitan New York, New Jersey and Connecticut
★ Over 20,000 sq. ft. of street level space to serve you more efficiently
★ Larger and more complete stocks of JAN and industrial components, plus latest testing equipment
★ Greatly enlarged switchboard to speed your calls
★ Increased competent personnel to serve you
★ Complete expediting staff to locate all hard-to-get items
★ Three spanking new audio studios
★ Over 150 ft. of service counters

Write for FREE Parts Catalogue

Sun Radio & ELECTRONICS CO. INC.
650 Sixth Ave. at corner of 20th St., New York, N. Y. ORegon 5-8600
Open Daily & Saturday 8:30-6:00

SECON

DEVELOPMENT and PRODUCTION
METALLURGISTS

Fine wire and ribbon in base, rare, and
precious metals, and alloys for
new and highly engineered applications.
In small units and sizes,
and to close tolerances.

Further details on request.

SECON

SECON METALS CORPORATION
228 East 45th Street, N. Y. 17, N. Y., MU 7-1594

It's New!

CML MODEL 1135
REGULATED POWER SUPPLY

Here at last is a truly universal power supply that will fill a majority of laboratory applications.

OUTPUT #1

Regulated "B" supply in two voltage ranges. 0-150 volts 150-300 volts with a current range of 0-20. MA. Regulation of 150-300 V range better than ¼% no load to full load. On 0-150 volt range, regulation from .25 volts to 6 volts .2 volt, improving to ¼% from 20 volts to 150 volts. Ripple and noise output less than one millivolt under all operating conditions.

OUTPUT #2

0-100 volts regulated "C" bias at zero current output, noise and ripple less than 50 millivolts.

OUTPUT #3

Unregulated 6.3V, 5 ampere heater supply. The Model 1135 is mounted on a standard 8¾ x 19" rack panel with a chassis depth of 13". The Model 1135-C is housed in a standard rack cabinet for bench use. Write for the new CML catalog describing the Model 1135 and other CML products.

Communication Measurements Laboratory, Inc.
350 Leland Ave., Plainfield, N.J.
Tel. PL-4 5502

MEMBERSHIP

The following transfers and admissions were approved to be effective as of March 1, 1953:

Transfer to Senior Member

Allerton, G. L., R.F.D. 4, Allentown, Pa.
Ayres, W. R., 311 W. Oakland Ave., Oaklyn 6, N. J.
Benham, T. A., Haverford College, Haverford, Pa.
Biggs, J. A., 725-19 St., S.E., Cedar Rapids, Iowa
Chenery, P. J., 339 Highbrook Ave., Pelham 65, N. Y.
Crispell, H. L., 720 Cornish Dr., San Diego 7, Calif.
DeMinco, A. P., c/o W. Leyden Stage, Lee Center, N. Y.
dePasquale, R. H., Windy Hill, 700 West St., Harrison, N. Y.
Fischer, L. G., 200 Gold St., Apt. 11-N, North Arlington, N. J.
Elbinger, L. P., Illinois Institute of Technology, Electrical Engineering Department, 3300 S. Federal, Chicago 16, Ill.
Gissing, H. R., c/o Northern Electric Co., Ltd., 65 Rorie St., Winnipeg, Man., Canada
Haefner, S. J., 109 Ridgewood Ave., New London, Conn.
Harvey, G. L., 196 Horton Hwy., Mineola, L. I., N. Y.
Horne, C. F., 222 Virginia Ave., Alexandria, Va.
Howell, F. S., 313-B Tyler St., China Lake, Calif.
James, R. L., 1830 Shaftesbury, Dayton, Ohio
Leger, R. M., MTD. R.F.D. 2, Palatine, Ill.
McGaughan, H. S., 502 Coddington Rd., Ithaca, N. Y.
Mizell, M. H., 501 Avondale Ave., West Los Angeles 49, Calif.
Nelson, N. A., 310 Lewiston Rd., Dayton 9, Ohio
Pleasure, M., 3713-74 St., Jackson Heights 72, L. I., N. Y.
Porter, N. E., 1585 Edgewood Dr., Palo Alto, Calif.
Ratts, B. H., 2506 Terrace Rd., Fort Wayne 3, Ind.
Rowe, D. E., 3617 School St., Riverside, Calif.
Rosenberg, P., 100 Stevens Ave., Mount Vernon, N. Y.
Ryan, C. M., USN, U. S. Naval Postgraduate School, Monterey, Calif.
Scheiner, S. R., 3917 Wabash Ave., Baltimore 15, Md.
Seeberger, L. M., 541 Park Dr., Woodbury, N. J.
Shepard, B. R., 201 Alexander Ave., Scotia 2, N. Y.
Skipper, L. C., 5 Warner Ave., Roslyn Heights, L. I., N. Y.
Trittenbach, J. M. P., 2106 Berwyn Ave., Chicago 25, Ill.
Webb, H. D., 812 W. Delaware Ave., Urbana, Ill.
White, E. S., 194-01 B 64 Cir., Fresh Meadows 65, L. I., N. Y.

Admission to Senior Member

Gallo, P., 66 W. Chestnut Ave., Merchantville, N. J.
Head, H. T., 342 Munsay Bldg., Washington 4, D. C.
Kent, G. J., 145 West 86 St., New York 24, N. Y.
Pfleger, K. W., c/o Bell Telephone Laboratories, Inc., 463 West St., New York 14, N. Y.
Pinciroli, A., Istituto Ellettrotecnico Nazionale, "Galileo Ferraris," Corso Massimo d'Azeglie, 42, Torino, Italy
Shoaf, J. R., II, 22 E. Browning Rd., Collingwood 7, N. J.
Sonnenfeldt, R. W., Apt. 266B, Haddon Hills, Haddonfield, N. J.
Sterner, J. F., 205 E. Buttonwood St., Wenonah, N. J.
Yarbrough, J. E., Orlando Broadcasting Co., Inc., Box 3707, Orlando, Fla.
Zenor, H. M., Box 7415, Houston 8, Tex.

Transfer to Member

Bassler, S. G., 43 Sixth Ave., Long Branch, N. J.
Bartholomew, R. G., 526 W. Broad, Quakertown, Pa.
Bellor, W. F., 186 Dorsey Rd., Rochester 16, N. Y.
Boyle, H., 89C Nithdale Rd., Plumstead, London S.E. 18, England
Bright, R., Jr., 44 Beaver St., New York 4, N. Y.
Eckert, J. A., Jr., 5514 Ruthelen St., Los Angeles 62, Calif.
Evans, R. J., 4133 Lake Lansing Rd., East Lansing, Mich.
Kreis, R. J., 508 Chatham, Columbus 14, Ohio
Kuehn, R. L., 437 Broad Ave., Palisades Park, N. J.
Ladof, L. G., 2023 Cecilia Pl., Seaford, N. Y.
Langevin, R. Z., 703 S. View Way, Redwood City, Calif.
Lee, R. E., 205A Entwistle St., China Lake, Calif.
Linhardt, R. J., 57 Van Breeman Dr., Clifton, N. J.
Lowe, M. H., 1941-82 St., Brooklyn 14, N. Y.
Mahurin, C. R., 2131 Byron St., Palo Alto, Calif.
Nissen, J. H., 1057 Stratford Ave., New York 72, N. Y.
Pattenson, C. F., 3 Braemer St., Ottawa 2, Ont., Canada
Pollack, P., 5668 Montezuma Rd., San Diego 15, Calif.
Rogers, C. E., Jr., 717 Santander Ave., Coral Gables 34, Fla.
Ropa, R. L., 115-19 St., Hermosa Beach, Calif.
Schwartz, L. J., 823 Doughty Ave., Franklin Square, L. I., N. Y.
Sheffield, A. G., Box 22 Woodroffe, Ottawa, Ont., Canada
Skillman, B. D., 4957 University Ave., San Diego 5, Calif.
Spooner, A. J., 1415 Westwood Blvd., Oklahoma City 8, Okla.
Trock, R., 251-37-71 Ave., Bellerose, L. I., N. Y.

(Continued on page 254A)

CUSTOM DESIGNED PROTECTION
for SUB-MINIATURE TUBES . . .

THE NEW STAVER SUB-MINI-SHIELD

Here is a combination Shield, Clip and Mount to meet your T3 Sub-Miniature Tube holding and shielding requirements.

Wrap-around shield (A) assures close tube to shield contact for maximum heat dissipation. Firm clamping action of phosphor bronze shield mount (B) secures tubes under the most severe conditions of vibration and shock. Easy-to-get-at rivet holes in base of mount facilitate easy riveting of mount to chassis.

Sub-Mini-Shields are now available for tube types T3-1, T3-2, T3-3, and T3-4; Diameter .366" to .400".

THE Staver COMPANY INCORPORATED

Manufacturers of the famous:
MINI-SHIELDS & MINI-SPRINGS
Bay Shore, Long Island, N. Y.
Bay Shore 7-3620

Our Engineering Department welcomes your special Subminiature Shielding problems!

GRAPHIC RECORDERS

FOR AUTOMATICALLY PLOTTING both ANGULAR and STRAIGHT LINE functions on either POLAR or RECTILINEAR coordinates in any COMBINATION . . .

- Records both AC and DC voltage levels
- Designed for STANDARD 8½ x 11 chart sheet
- POLAR and LINEAR turntable movement
- TURNTABLE instantly set to any chart position
- Auxiliary Electrical linkage for synchronizing to turntable motion: Oscillators Rotational Devices Test Turntables Analyzers
- Interchangeable range potentiometers
- Dependable and service free operation

Typical applications:

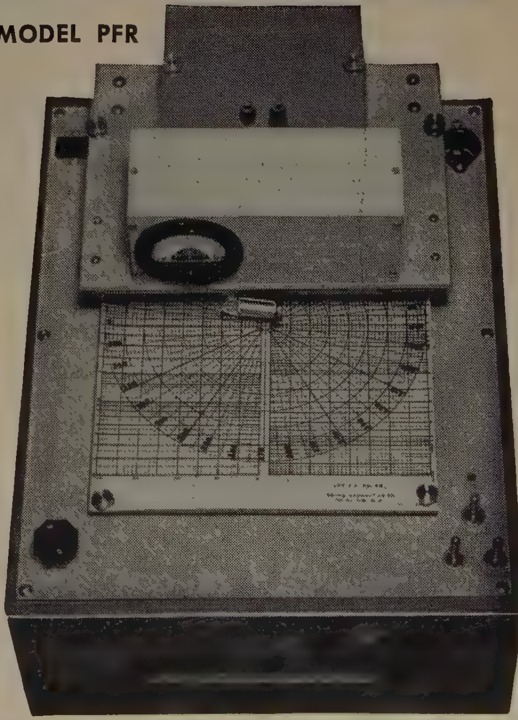
Beam Pattern Plotting of antennas, microphones, loudspeakers, lighting fixtures, ultrasonic devices;

Frequency Response Records of microphones, loudspeakers, amplifiers, Filters, Radio and television circuits;

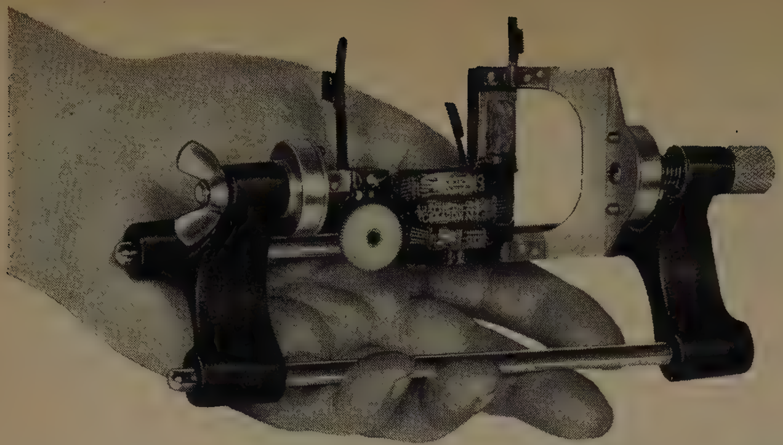
Rectilinear Curves on vacuum tubes, potentiometers, amplifiers, counting and computing devices.

Literature on Model PFR mailed upon request

MODEL PFR



Designers and Manufacturers of Graphic Recorders
SOUND APPARATUS COMPANY · STIRLING, N. J.
Instruments Engineered for Individual Requirements



Let "TINY-FIX" be your *THIRD HAND*

SEE TINY-FIX, your "THIRD HAND" for small wiring and assembling.

SEE TINY-FIX's "big brother" Assembly Fixtures—stocked in all sizes. Extra long base rods are available on request.

SEE PTF's Pin Straighteners, Masking Plugs, and Test Plugs stocked in standard sizes for immediate delivery.

SEE PTF's experienced Designers to discuss special production problems.

SEE PTF's new revolutionary, *universal* TV Fixture Adapter.

Call, write or wire for detailed information today.

SEE them all
at the
I.R.E. SHOW
Booth 3-522

PRODUCTION
Tool & Fixture Co.

37 WEST MAIN ST.
OYSTER BAY, N. Y.
Phone: OYster Bay 6-0009

These
OIL DIFFUSION PUMPS
are only two members from our
COMPLETE LINE

SEE the latest one in action at
Booth 4-216—IRE SHOW
March 23-26

See also our SC-3 High Vacuum Evaporator, evaporated films, vacuum accessories, etc.

OPTICAL FILM ENGINEERING CO.
2731-37 North 6th St. • Philadelphia 33, Pa.

VISIT
OPEN HOUSE
Hi-Fidelity Audio Show
at
Florentine Room, Hotel Lexington
(right across the street from the Palace)

THORDARSON MEISSNER
Mt. Carmel, Illinois

MEMBERSHIP

(Continued from page 253A)

Trueblood, D. B., 911 N. Rudolph St., Goldsboro, N. C.
Viener, A. H., 3817 Stokes Dr., Baltimore 29, Md.
Votava, Y., Box 277, Griffiss AFB, Rome, N. Y.
Wilkinson, J. E., 410 W. First St., Dayton 2, Ohio

Admission to Member

Ahlgren, W. E., 192 Elm St., San Carlos, Calif.
Alter, A. C., Via Tor Fiorenza 28, Rome, Italy
Andersen, E. A., 2256 San Francisco Ave., Long Beach 6, Calif.
Ashley, A. B., 4913 N. Miller, Oklahoma City 12, Okla.
Black, E., 1701 N.W. 35, Oklahoma City 6, Okla.
Bradley, W. H., 1226 Beechview Dr., S.E., Atlanta, Ga.
Brown, A. C. L., 1641 Ridge Ave., Evanston, Ill.
Burdick, G. E., c/o New England Conservatory of Music, 290 Huntington Ave., Boston, Mass.
Carter, G. E., Jr., Bomac Laboratories, Inc., Salem Rd., Beverly, Mass.
Delk, E. T., 1627 N. Belmont, Wichita 14, Kans.
Ebert, H. K., Jr., Blacksburg, Va.
Fonseca, N. J., A/C Apartado 3276, Caracas, Venezuela, S. A.
Garon, R. J., c/o Wyle Laboratories, 340 E. Franklin, El Segundo, Calif.
Gladding, E. B., USN, 6000 Benalder Dr., Fairway Hills, Washington, D. C.
Griffin, P. W., Third and Elm St., Dunn Loring, Va.
Hadady, R. E., Audio & Video Products Corp., 261 Constitution Ave., N.W., Washington 1, D. C.
Hardesty, G. A., 820 Robinson St., West Lafayette, Ind.
Heuer, C. H., 1095 Merrill St., Winnetka, Ill.
Hoag, D. S., R.F.D. 1, Schuylerville, N. Y.
Horowitz, L. A., 27-B Parkway Apts., Haddonfield, N. J.
Howe, J. K., 7344 N. Odell Ave., Chicago 3, Ill.
Howell, E. K., 209 Marilyn Ave., North Syracuse, N. Y.
Jahren, A. S., Jr., 282 Linden Ave., Dayton 3, Ohio
Jones, R. M., 821 N.W. Seventh St. Rd., Miami 36, Fla.
Keller, J. W., Jr., 126 Forrester St., S.W., Washington 20, D. C.
Kidwell, N. E., 6 Middle Dr., Windsor Locks, Conn.
Kilham, L. F., 140 Main St., Concord, Mass.
King, R. C., 176 Hedge Rd., Menlo Park, Calif.
Kinney, E. S., 2500 Maywood Ave., San Jose, Calif.
Lamont, K., 116 Crystal Palace Park Rd., Sydenham, London S.E. 26, England
Lanning, W. C., 30 Relda St., Plainview, L. I., N. Y.
Latham, C., Air Service Training, Ltd., Technical Training College, Jalahalli, Bangalore, Mysore State, India
Lazecki, S., 937 Hare Ave., Box 3, Westboro, Ottawa, Ont., Canada
LeGendre, V., 432 W. Colfax Ave., Roselle Park, N. J.
Levy, G. I., Caixa Postal 8026, Sao Paulo, Brazil
Long, R. G., 21 Clive Rd., Scarborough Bluffs, Ont., Canada
Lubbert, G. L., 5609 Merville Ave., Baltimore 15, Md.
MacAdam, J. F., Box 132-W, Oklahoma City, Okla.
Mass, J., Box 1, Kiryat Motzkin, Haifa, Israel
Miller, M. D., 3618 Mossman, Wichita 6, Kans.
Nord, G. L., 4500 Alpine Ave., Cincinnati 36, Ohio
O'Kelley, H. E., 22-A Graves Apts., Auburn, Ala.
O'Meara, J. P., Southwest Research Institute, 8500 Culebra Rd., San Antonio 6, Tex.
Olson, H. M., 26 Hillside Ave., Cedar Grove, N. J
Perrier, J. F., Bldg. 3, Apt. 2B, Jacob Ford Village, Morristown, N. J.

(Continued on page 256A)

Relax with DALIS

during the I.R.E. SHOW

When your dogs begin to bark and your back shouts, "Let's quit for awhile" — walk across the street to our suite at the BELMONT-PLAZA (48th and Lex.), where H. L. Dalis, Inc., provides refreshments — liquid and solid — plus a comfortable chair or two. You are invited to sit and sip and relax and rest for awhile. We're not going to talk business or sell you anything. This is a Dalis-Service to you . . . because we've been to Shows before, and we know how tired a man can get.

P.S. . . . *If you plan to go out in the evening and haven't time to go home or to your hotel — you can shave or freshen up at our suite — we'll have all the fixin's for you.*

Seal of HLD Service

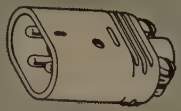
H. L. DALIS INC.

WHOLESALE DISTRIBUTORS
ELECTRONIC EQUIPMENT
175 VARICK ST., NEW YORK 14

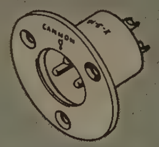
Serving the Metropolitan New York Area with Electronic Parts and Equipment for Over 25 Years!

CANNON PLUGS *get good reception*

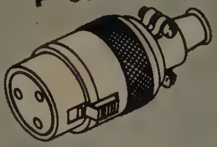
O SERIES



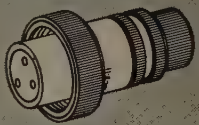
X SERIES



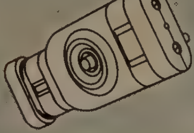
P SERIES



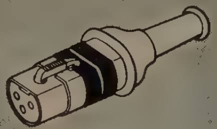
XK SERIES



GB SERIES

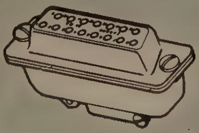


UA SERIES

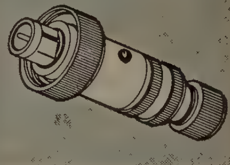


XL SERIES

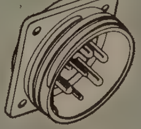
D SERIES



XKW-B1 SERIES



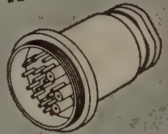
K SERIES



TELEPHONE RECORDER

U SERIES

K SERIES



TELEVISION

WRITE FOR PRICE FOLDER CPL-6

The high quality audio connectors shown above are available from all Cannon Franchised Distributors. In their great variety of sizes, shapes and contact arrangements there is no problem or technical requirement in the radio, sound, TV or related fields that cannot be met. Cannon plugs are standard on leading makes of audio equipment and microphones.

SEE
Cannon Electric
Booth 2-512
Radio Engineering
Show
March 23-26
Grand Central Palace
New York

CANNON ELECTRIC

Since 1915

Factories in Los Angeles, Toronto, New Haven, Benton Harbor. Representatives in principal cities. Address inquiries to Cannon Electric Company, Dept. C-377, P.O. Box 75, Lincoln Heights Station, Los Angeles 31, California.

STANDARD
Radio Interference and Field Intensity
MEASURING EQUIPMENT
Complete Frequency Coverage—14kc to 1000 mc!

VLF
14kc to 250kc
Commercial Equivalent of AN/URM-6B.
Very low frequencies.

HF
150kc to 25mc
Commercial Equivalent of AN/PRM-1A. Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies. Has B.F.O.

VHF
15mc to 400mc
Commercial Equivalent of TS-587/U.
Frequency range includes FM and TV Bands.

UHF
375mc to 1000mc
Commercial Equivalent of AN/URM-17.
Frequency range includes Citizens Band and UHF color TV Band.

These instruments comply with test equipment requirements of such radio interference specifications as MIL-I-6181, MIL-I-16910, PRO-MIL-STD-225, ASA C63.2, 16E4, AN-I-24a, AN-I-42, AN-I-27a, MIL-I-6722 and others.

STODDART AIRCRAFT RADIO Co., Inc.
6644-C Santa Monica Boulevard, Hollywood 38, California

MEMBERSHIP

(Continued from page 254A)

Pollack, M., 3096 Brighton Sixth St., Brooklyn 35, N. Y.
Powell, N. E., 106-A South Cornell, Albuquerque, N. Mex.
Roberts, J. G., "Little Meadow," 40 Barrow Bridge Rd., Bolton, Lancs., England
Roggenstein, E. O., 140 Main St., Box 683, Norwalk, Conn.
Sakamoto, T., Electrical Engineering Department, University of Tokyo, Bunkyo-ku, Tokyo, Japan
Samsky, B. S., 588 North Broadway, Saratoga Springs, N. Y.
Schreiber, E. J., 2339 Elsmere Ave., Dayton 6, Ohio
Scull, J. R., 1325 N. Wilson Ave., Pasadena 6, Calif.
Shoaf, J. H., 2923 Weisman Rd., Silver Spring, Md.
Smith, H. C., McKinley High School, King St., Honolulu, Hawaii
Spanier, B., 5201 D Blanco St., El Paso, Tex.
Taylor, W. G., 2117 S. Curtis Alhambra, Calif.
Tyron, J. G., 191 Hillside Ave., Chatham, N. J.
Vangunten, L. F., 2323 Eden La., Dayton 3, Ohio
Watstein, J. I., 7937 Essex Ave., Chicago 17, Ill.
Wertman, R. C., 442 Hamilton Pl., Hackensack, N. J.
Wood, R. M., 4458 Tiedeman Rd., Brooklyn, Cleveland 9, Ohio

The following elections to the Associate grade were approved to be effective as of February 1, 1953:

Alcott, E. H., 179-06 Anderson Rd., Springfield Gardens, L. I., N. Y.
Allen, C. F., Box 3054 USAFIT, Wright-Patterson AFB, Ohio
Alman, J., 401 Helen St., Vestal, N. Y.
Alsabrook, C. M., 113 James St., Burlington, N. C.
Amedeo, P., 42-22-161 St., Flushing, L. I., N. Y.
Appelbaum, G., 367 E. 48 St., Brooklyn, N. Y.
Axford, W. R., 215 Weldy Ave., Oreland, Pa.
Ayer, W. T., Radio WBEC, 30 Eagle St., Pittsfield, Mass.
Baker, A., Raytheon Manufacturing Co., 148 California St., Newton 58, Mass.
Baker, M. L., 403 Landfair Ave., Los Angeles, Calif.
Balugo, J. J., 707 E. 89 St., Los Angeles 2, Calif.
Barres-Barreto, L. A. G. C., Inst. Tecno. De Aero., S. Jose Des Campos, Est. S. Paulo, Brasil
Barrowcliff, T. A., 406 Grover Cleveland Hgwy., Buffalo, N. Y.
Bastian, A. L., 7 Burbank St., Yonkers, N. Y.
Belcher, R. D., 82 Railroad Ave., Valhalla, N. Y.
Bell, R. W., 576 Center Dyre Ave., West Islip, L. I., N. Y.
Bentivegna, M. J., 65 Coit St., Irvington 11, N. J.
Bergeron, W. F., 4 County St., Ipswich, Mass.
Berlin, J., 1832-64 St., Brooklyn, N. Y.
Bickel, S. O., 2201 Riedmiller Ave., Fort Wayne, Ind.
Blair, D. R., 180 S. Alvardo St., Los Angeles, Calif.
Blumenberg, A., 66 Pinehurst Ave., New York, N.Y.
Bode, G. F., 1302—18 St., N.W., Washington, D. C.
Bondarenko, A. J., 333 Jackson Ave., New York, N.Y.
Boyd, C. H., Box 512, Grand Rapids, Mich.
Brett, C. F., 5622 E. Sewells Point Rd., Norfolk 13, Va.
Brinker, H., 60—48 Woodbine St., Ridgewood, L. I., N. Y.
Bryson, V. E., 7315 Fairchild Ave., S.E., Albuquerque, N. Mex.
Buehler, 10150 Dallas Ave., Silver Spring, Md.
Burdick, D. D., 484 Richmond Ave., Buffalo 22, N. Y.
Caldwell, Burn Brae, Clifton Heights, Pa.
Candiotti, J., 201 S. Fourth St., Brooklyn, N. Y.
Castown, R. W., 142 Manhattan Ave., New York, N. Y.

(Continued on page 258A)

. . . with

Silic-O-Netic TIME DELAY RELAYS

TIME DELAY is a basic requirement of many common electronic circuits. Thyratrons and gas filled rectifier tubes, particularly, must be protected to obtain any semblance of satisfactory life.

The facts are simple:
Time delay permits the tube to heat before the load is applied; otherwise a coating forms on the cathode which quickly destroys its effectiveness.

Operating principle is explained in Bulletin 5001A. Send for your copy.

HEINEMANN *Silic-O-Netic* Time Delay Relays have a unique combination of characteristics ideally suited to cathode protection. They are both low cost and fully dependable; small in size and lightweight. They are all metal, yet the time element is hermetically sealed . . . forever free of dirt and not subject to a fatigue factor. *Silic-O-Netic* Relays employ no thermal elements . . . thus they are not affected by the normal ambient temperature variations of electronic equipment.

don't use heat

. . . USE POWER

HEINEMANN

ELECTRIC COMPANY

154 Plum Street Trenton 2, N.J.

29 Years of Service to the Radio Manufacturing Industry

BAUMAN & BLUZAT

Serving the Mid-West
And Representing These Outstanding Manufacturers

- **Automatic Electric Mfg. Co.**
  Mankato, Minn.
  Relays—Timers—Flashers
- **Ballastran Corporation**
  Ft. Wayne, Ind.
  Transformers, Commercial—and to Military Specs.
- **The Barry Corp.**
  Watertown, Mass.
  Barry Mounts, Shock & Vibration Control
- **Cambridge Thermionic Corp.**
  Cambridge, Mass.
  Coil Forms, Terminal Boards, Lugs & Radio Hardware
- **Chicago Condenser Corp.**
  Chicago, Ill.
  Oil Impregnated, Wax Tubular & Hermetically Sealed Condensers
- **Eastern Air Devices**
  Brooklyn, N.Y.
  Fractional H. P. Motors to JAN Specs.
- **Kemtron Electron Products Co.**
  Salem, Mass.
  Germanium & Silicon Diodes
- **Kings Electronics**
  Tuckahoe, N.Y.
  Connectors, Microwave Components
- **Reeves-Hoffman Corporation**
  Carlisle, Penn.
  Quartz Crystals

Consulting • Engineering • Sales & Service

2753 W. North Ave.
Chicago 47, Illinois
TWX; CG-1700 **Mobile; WJ 4-3204**
HUmboldt 6-6809

NEW! . . . an instrument for all your magnetic measuring problems.

Dyna-Labs
D-79
GAUSSMETER

This precision built instrument measures flux density, determines direction of flow. It locates and measures stray fields and plots variations in strength and checks production lots against a standard. Simple to operate. No ballistic readings . . . no jerking or pulling. Supplied with protective carrying case.

- Other Features -
- Reads 10 to 30,000 Gauss Flux Fields
- Probe is only .025" thick
- Active area .01 square inches
- Overall size 13" x 6-3/4" x 10-1/2"
- Net weight only 10-1/2 lbs
- Power supply 105-125 volts, 50-60 cycles

We invite inquiries. For literature write Department IRE-353.

Dyna-Labs INC.
1075 STEWART AVENUE, GARDEN CITY, L. I., N. Y. GARDEN CITY 3-2700

Electronics Mfrs. . . See Birnbach!

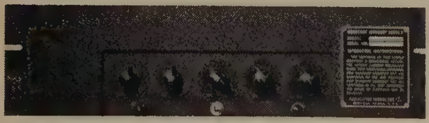
Cut production costs, speed operations, by specifying BIRNBACH — your DEPENDABLE Source of Supply!
COMPLETE WAREHOUSE STOCKS
Write for Catalog 53-1

For All Your Needs in
Radio - Electronic - Television

Gov't Specification
- Hook-Up Wire
  SRIR-SRHV
  JAN-C-76
  Thermoplastic
  WL-Glass Braid
  Nylon Jacket
  105° C. UL Approved
- Wire—Cable
- Guy Wire
- Aluminum Wire
- Magnet Wire
- Jacks—Plugs
- Insulators
  Steatite-Ceramic
- Hardware
- Accessories
- Test Leads
- Vinyl Extruded and Radio Grade Tubing

BIRNBACH RADIO CO. INC.
145 HUDSON STREET
NEW YORK 13, N. Y.

Manufacturers of Quality Products for the Electronics Industries,— Serving since 1923



RACK MOUNTING MODELS

105-125 V, 60C INPUT

OUTPUT CURRENT MAY BE SET AT ANY VALUE BETWEEN 0.2 AND 50 M.A. D.C. INCLUSIVE.

AS LOAD VOLTAGE VARIES BETWEEN 0-150 V. MODEL 1A-R IS CONSTANT WITHIN 1%, MODEL 1 B-R WITHIN 0.1%.

ELECTRONICALLY REGULATED
D.C. CONSTANT CURRENT
POWER SUPPLIES

OUTPUT CURRENT IS HELD CONSTANT AS LOAD VARIES

OTHER MODELS AVAILABLE
WRITE DEPT. 101 FOR LITERATURE

ASSOCIATED SPECIALTIES CO.
1751 MAIN STREET
OREFIELD, PENNSYLVANIA

MEMBERSHIP

(Continued from page 256A)

Cesario, D. J., 2739 Sheffield Ave., Chicago, Ill.
Cheeseman, P. R., Palmer Physical Laboratory, Princeton University, Princeton, N. J.
Chowdary, T. H., Control Room, Broadcasting House, New Delhi, India
Churchon, S. P., 2104 Lyon Ave., Belmont, Calif.
Clee, L. W., 2110 W. Olmos Dr., San Antonio 1, Tex.
Coachman, J. E., 8 Roosevelt Rd., Maplewood, N. J.
Cohen, L. A., 357 E. 95 St., Brooklyn, N. Y.
Conrad, R. W., Box 212, Weston 93, Mass.
Cool, P. E., R.F.D. 1, Medway, Ohio
Cooper, J. I., 135 Winding Way, San Carlos, Calif.
Cora, A. M., Jr., 1220 N. Broad St., Philadelphia, Pa.
Cordray, R. E., 20 Oak Ter., Neptune City, Avon, N. J.
Crane, P. H., 421 W. 21 St., New York 11, N. Y.
Creacy, J. N., 2308 Roberts St., Wichita Falls, Tex.
Cullom, J. H., 4708-B Gateway Ter., Baltimore, Md.
Davis, J. L., Box 907, Pasadena, Tex.
Delp, R. H., Redstone Arsenal, Huntsville, Ala.
Dite, W., 18 Manhattan Ct., Nutley 10, N. J.
Dodgson, J. G., 5406 Hamilton St., Apt. 3, Rogers Heights, Md.
Donat, O. E., Keystone Products Co., 904—23 St., Union City, N. J.
Doty, W. E. N., Development and Research Department, Continental Oil Co., Ponca City, Okla.
Dunn, C. J., 6 Greenmeadow Rd., Tuckahoe 7, N. Y.
Eames, F. M., Jr., 4920 Dinsmore Rd., Dayton, Ohio
Eckess, W. S., Jr., 1300 Oakland Rd., N.E., Apt. 1408, Cedar Rapids, Iowa
Edwards, D. F., Box 3133, USAFIT, Wright-Patterson AFB, Ohio
Edwards, J. M., Southwestern Bell Telephone Co., 900 W. Fifth St., Little Rock, Ark.
Elders, D. S., 14 James St., Englewood, N. J.
Elkins, R., 88-28—188 St., Hollis, L. I., N. Y.
Elliott, W. S., R.F.D. 2, Cedar Rapids, Iowa.
Fierstein, J. H., 329 Wister St., Philadelphia, Pa.
Frank, J., 105 Winthrop St., Brooklyn 25, N. Y.
Fritsche, A. J., 424 E. 52 St., New York, N. Y.
Gardner, R. A., 733 W. Vineyard, Anderson, Ind.
Gensel, W. L., 1309 Northup Rd., Drexel Hill, Pa.
Gessner, R. J., 4619 Ninth St., N.W., Washington, D. C.
Gignoux, F. E., 2515 Massachusetts Ave., N.W., Washington, D. C.
Gillis, J. F., Box 296, Hartsdale, N. Y.
Goff, W. S., Jr., Box 3151, USAFIT, Wright-Patterson AFB, Ohio
Goldberg, O. D., 20 Springate St., Utica 4, N. Y.
Goldberg, S. R., 306 Terrace Ave., Hasbrouck Heights, N. J.
Goodwin, J. W., 2123 Guilford Rd., Hyattsville, Md.
Guyton, R. D., 5109 Flagstone Dr., Fort Worth, Tex.
Hall, H. S., 2001 Alsace Rd., Reading, Pa.
Harris, V. E., U. S. Fish and Wildlife Service, Marine Laboratory, University of Miami, Coral Gables, Fla.
Hartmann, H., 409 Third Ave., Haddon Heights, N. J.
Hartzell, R. A., Box 3166, USAFIT, Wright-Patterson AFB, Ohio
Hayden, H. P., Box 2902, Baltimore, Md.
Henkle, H. H., 86 E. Randolph St., Chicago 1, Ill.
Hemmer, F. A., Jr., 4 Osborne Ter., Maplewood, N. J.
Hibbard, H. C., 1347 S. Florence, Tulsa 3, Okla.
Hickok, F. A., 56 Cedar St., East Weymouth 89, Mass.

(Continued on page 260A)

Top Service

IS ASSURED WHEN YOU ORDER YOUR

RAYTHEON TUBES and JUNCTION TYPE TRANSISTORS

FROM

DALIS

Metropolitan New York's Foremost Electronic Distributor

Immediate Delivery From Stock

Seal of HLD Service

PHONE: ALgonquin 5-3000
WRITE or WIRE: Dept. IND
TELETYPE: N. Y. 1-2482

H. L. DALIS INC.
WHOLESALE DISTRIBUTORS
ELECTRONIC EQUIPMENT
175 VARICK ST., NEW YORK 14

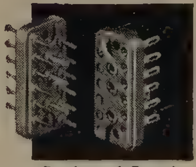
SERVING THE TRADE FOR OVER A QUARTER CENTURY

See us in
BOOTH 4-520
RADIO ENGINEERING SHOW
Grand Central Palace
March 23-26

A long established symbol .. *in electronics*

AN Types

RF Types



Rack and Panel

Cable Assemblies

FOR THE PAST 20 years we've been applying our skills to problems in *research, design, engineering,* and *manufacture* of connectors and component parts for many of America's best known companies in the electronics and communications industries.

OUR CRAFTSMEN have been and are now producing parts that exceed the most exacting requirements. Our task is to make the H. H. Buggie And Company symbol even more important to you through manufacture of products equal to the importance you attach to them.

IN ADDITION to the products illustrated at left, H. H. Buggie And Company designs, engineers, and manufactures many special parts and assemblies. We invite your inquiries.

H. H. BUGGIE
And Company
TOLEDO 4, OHIO
Sales Engineers in All Principal Cities

Skilled in Electronic Component Parts
RESEARCH • DESIGN
ENGINEERING
MANUFACTURING

NEW. . THE CB MODEL 712 C-R-L BRIDGE

Measures Capacitance, Resistance, Inductance, Insulation Resistance, the Turn Ratio of Transformers, DC Leakage, Current of Capacitors, Dissipation Factor "D" and Storage Factor "Q"

10 MMF to 1100 MFD

1 OHM to 11 Megohms

100 Microhenries to 110 Henries

Insulation Resistance Up to 10,000 Megohms

Turns Ratio .01 to 110

DC Voltage for Polarizing Electrolytics 0-500 V

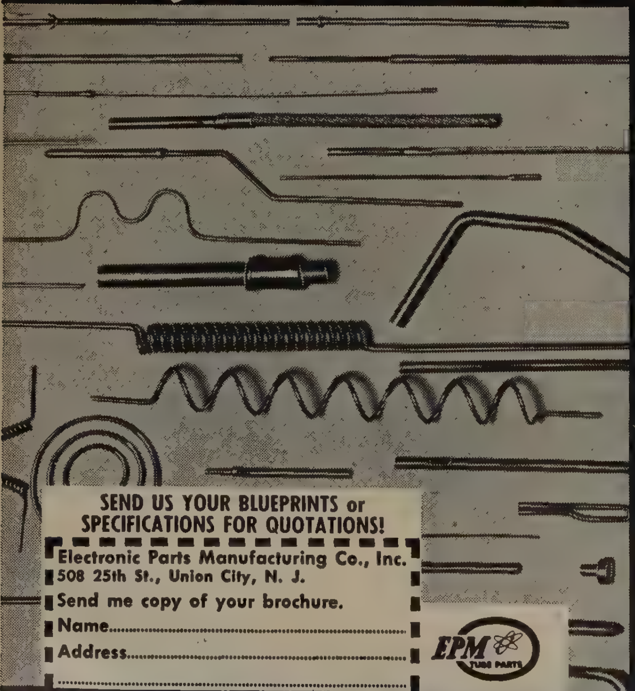
Meter Measures Polarizing Voltage and Leakage Current

Capacitor Quality Test for Open or Shorted Capacitors Without Disconnecting From Circuit

CB MODEL 712
Small size—light weight—high accuracy. For complete construction details and performance data write for Bulletin 27D.

The CLOUGH BRENGLE Co.
6014 Broadway Chicago 40, Ill.

improve your products with QUALITY COMPONENTS



quality hand-wound COILS of Tungsten and Molybdenum

quality "precision" LEADS of TUNGSTEN MOLYBDENUM NICKEL NICKEL-CLAD COPPER and ALLOYS

quality MACHINED TUBE COMPONENTS to customers' specifications

SEND US YOUR BLUEPRINTS or SPECIFICATIONS FOR QUOTATIONS!

Electronic Parts Manufacturing Co., Inc.
508 25th St., Union City, N. J.
Send me copy of your brochure.
Name..
Address..
....

ELECTRONIC PARTS MANUFACTURING CO., Inc.
508 25th St., Union City, N. J.
VISIT BOOTH 3-508 IRE SHOW, GRAND CENTRAL PALACE

MEMBERSHIP

(Continued from page 258A)

Hoffman, R. J., Rm. 1C336, Bell Telephone Laboratories, Murray Hill, N. J.
Holland, J. W., 37 Family La., Levittown, L. I., N. Y.
Hollepeter, W. C., 6620 Elmer Ave., North Hollywood, Calif.
Howland, I. R., Sheridan Village, 19-C4, Schenectady, N. Y.
Hubelbank, S. H., 363 Norton St., New Haven, Conn.
Hudson, J. L., 323 W. Lemon St., Lancaster, Pa.
Hurley, L., 2736 Rosemont, Shreveport, La.
Hyde, H. I., Rm. 22, Chemical Bldg., University of Arkansas, Fayetteville, Ark.
Isberner, M. P., 5061 W. Balmoral Ave., Chicago 30, Ill.
Jablonsky, J. G., 633 N. Lockwood Ave., Chicago 44, Ill.
Jacobs, M. G., 1535 Ocean Ave., Brooklyn, N. Y.
Jevons, L. O., 7723 Westlawn Ave., Los Angeles, Calif.
Johnson, D. E., 3115 W. 71 Ter., Prairie Village 13, Kans.
Kenney, J. R., 213 Blackburn Ave., Ottawa, Ont., Canada
Kerwin, W. J., 2895 Emerson St., Palo Alto, Calif.
Kiciak, C. J., 8316 Manistee Ave., Chicago 17, Ill.
Kiseleski, J. M., 319 Indiana Ave., Shenandoah, Pa.
Knowles, C. C., 14 Albany Ave., Brooklyn, N. Y.
Kohls, G. F., 1600 Emmons Ave., Dayton 10, Ohio
Kotzum, J., 346 Acacia St., San Francisco 24, Calif.
Kozma, E. Z., 1801 Maple St., Granite City, Ill.
Kreinheder, D. E., 272 Boston St., Syracuse, N. Y.
Lay, C. A., Jr., Box 3219, USAFIT, Wright-Patterson AFB, Ohio
Lee, R. W., 1029 Jackson St., San Francisco, Calif.
Lee, T. K., 134-35—59 Ave., Flushing, L. I., N. Y.
Lencioni, C. C., Jr., 201 S. Kedzie Ave., Chicago, Ill.
Leonard, H. Q., Box 3155, USAFIT, Wright-Patterson AFB, Ohio
Lin, C. S., 805 E 47 St., Austin, Tex.
Little, G. R., R.F.D. 1, West Moreland St., Whitesboro, N. Y.
Lockhart, E. H., 1506-K S. Catalina Ave., Redondo Beach, Calif.
Lockwood, R. A., Eighth Comm. Fleet, APO 942, c/o Postmaster, Seattle, Wash.
Long, B. J., Box 3207, USAFIT, Wright-Patterson AFB, Ohio
Long, J. A., Squawbuck Rd., Columbia City, Ind.
Long, J. E., Valparaiso Technical Institute, Valparaiso, Ind.
Low, R. C., 222 North Ave., E., Cranford, N. J.
Luchter, D., 1014 Myrtle Ave., El Paso, Tex.
Lucid, J. R., Box 3245, USAFIT, Wright-Patterson AFB, Ohio
Luttrell, N. H., Jr., 6036 Oregon Ave., N.W., Washington 15, D. C.
Mankiewicz, E. J., Box 72, AA & GM Branch, TAS, Fort Bliss, Tex.
Mann, J. R., 9584 TSU, Fort Monmouth, N. J.
Mannas, R. G., 3609 Windsor Mill Rd., Baltimore 16, Md.
Marple, M. O., 2158 Homer St., Philadelphia 38, Pa.
Mason, C. F., 412 N. Easton Rd., Willow Grove, Pa.
Mason, J. R., 303 W. Mt. Pleasant Ave., Philadelphia, Pa.
McDonald, R. D., 565 Edmonds St., New Westminister, B. C., Canada
Metzger, G. V., RCA Victor Division, Bldg. 13-7 IDF, Camden, N. J.
Miller, L. A., 1090 E. Kentucky St., Louisville, Ky.
Miller, L. G., Box 3221, USAFIT, Wright-Patterson AFB, Ohio

(Continued on page 262A)

These new books

will be at your Radio Engineering Show. Be sure to see them.

Flux Linkages & Electromagnetic Induction

by L. V. Bewley. An outstanding contribution to basic electrical knowledge, this book presents the reasons for the difficulties commonly encountered in problems involving induced voltages and simple, straightforward methods of analyzing and solving these problems. $3.50

Direct Current Machines for Control Systems

by A. Tustin. Explains in practical engineering terms the basic principles common to the various types of electronic control mechanisms, the comparative characteristics of the major types being manufactured today, and the salient features to consider in the selection and use of these mechanisms for a particular purpose. $10.00

Hearing Aids

by Matthew Mandl. Here for the first time is a clear, simple explanation of the major types of modern hearing aids in terms of their efficiency for the user and their service problems. Written both as a guide to the hard-of-hearing in the selection and use of a hearing aid and as a basic manual for the serviceman, this book will be a valuable sales aid to manufacturers and dealers as well as an excellent training text for their service personnel. $3.50

Qualitative Analysis and Analytical Chemical Separations
by P. W. West, M. M. Vick, and A. L. LeRosen (Febr. 24th)
The principles and laboratory techniques, including new, non-sulfide procedures.

Physical Chemistry 3rd Ed.
by F. H. MacDougall
New, up-to-date edition of a leading text, noted for its thorough, rigorous treatment of the subject. $6.00

Analytic Mechanics
by V. M. Faires & S. D. Chambers
New 3rd edition of the authors' well known "Mechanics of Engineering." $6.00

Calculus
by J. F. Randolph $5.00

Elementary Differential Equations
by E. D. Rainville $5.00

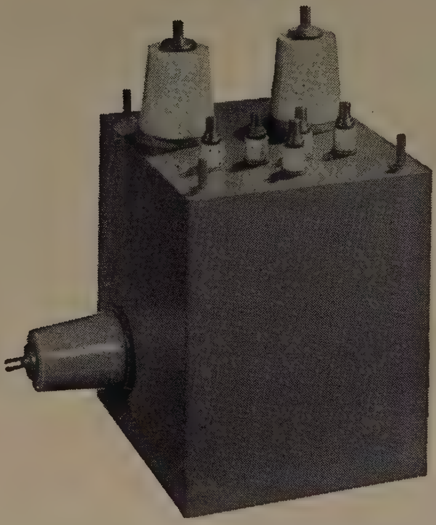
Laboratory Manual of Materials Testing
by R. T. Liddicoat & P. O. Potts
Full, up-to-date information on equipment and techniques. $4.00

These and many other important new books will be at Brentano's book (501-2) at the IRE show. Look them over there, or write us for further information.

The Macmillan Company
60 FIFTH AVENUE, NEW YORK 11, N.Y.

Kenyon

SPECIAL Transformers Have Many Applications



Kenyon oil-filled hermetically sealed transformers have particular application to pulse and high voltage plate transformers and to charging reactors.

They are specially valuable for reactors and plate transformers operating on 400 cycle or higher frequency primary supply voltage.

Because of their internal characteristics oil-filled transformers present different problems from conventional types. Cases must be correctly designed, terminals properly constructed and sealing methods highly efficient to eliminate oil leakage. Kenyon has successfully solved these problems.

The result is a unit with high quality insulation, small in size yet possessing excellent life and exceptional dependability.

Because of substantial savings in size and simplicity of insulation, use of Kenyon Oil-Filled Transformers frequently results in lower final cost.

Booth No. 1-615, I.R.E. Show

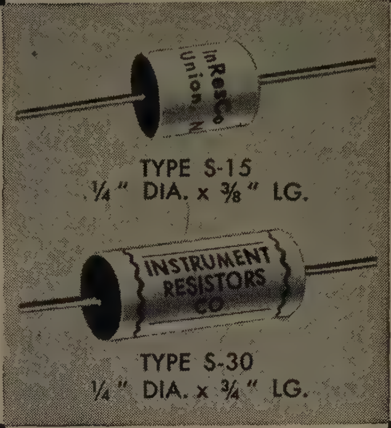
No matter what your transformer requirements may be contact Kenyon first. Our engineers will endeavor to show you how you can increase efficiency at low cost by choosing a transformer from the complete Kenyon line.

KENYON TRANSFORMER CO., Inc.
840 Barry Street, New York 59, N. Y.

sub-miniature AND moisture-proof

IN-RES-CO S-15 & S-30 WIRE WOUND RESISTORS

THE ECONOMICAL SOLUTION where moisture proof resistive elements of comparatively small size are required for commercial applications. Type S-15 is 3/8" long by 1/4" diameter; type S-30 measures 3/4" by 1/4" diameter. Both types are moisture proof and capable of high performance over long periods of continuous service. IN-RES-CO Resistors for every ordnance or civilian requirement are available at a cost that solves circuit design problems both performance-wise and cost-wise. Check up now, on the complete line of IN-RES-CO quality wire wound resistors.



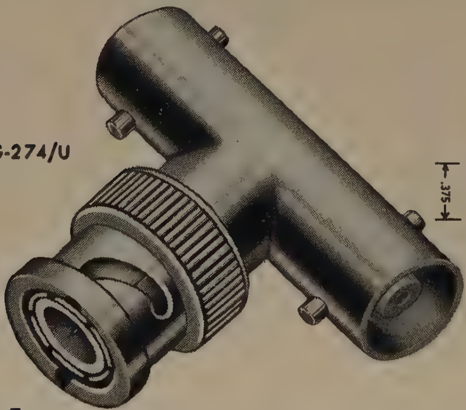
INSTRUMENT RESISTORS CO.
COMMERCE AVENUE · IN-RES-CO · UNION NEW JERSEY

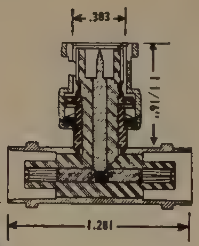
FOR JAN SPECIFICATION RESISTORS — consult the new illustrated literature describing the complete In-res-co line. Write for your copy today!

APPLICATION-DESIGNED RESISTORS FOR ELECTRONICS AND INSTRUMENTATION

QUALITY • QUANTITY • QUICKLY

Type BNC UG-274/U

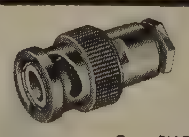




The Right Connection . . . right now!

Dage RF connectors are designed *right*, engineered *right*, built *right*—and available *now*. Each part is carefully made—Dage connectors are precision assembled to assure a sure connection.

Check your specifications—be sure you're *right*—ask for Dage radio frequency connectors.



Type BNC UG-88/U

ALWAYS SPECIFY DAGE

Dage is versatile . . . any standard or special RF connector can be quickly produced at Dage. Write for Catalog 101.

RADIO FREQUENCY CONNECTORS

DAGE ELECTRIC COMPANY, INC., 67 NORTH SECOND STREET, BEECH GROVE, IND.

MEMBERSHIP

(Continued from page 260A)

Miller, R. J., 541 Anderson Ave., Rockville, Md.
Millett, R. G., Bldg. 6, General Electric Co., Electronics Pk., Syracuse, N. Y.
Mills, R. J., Box 4, Harper Station, Detroit, Mich.
Moody, R. B., Hq. USAFIT, Box 3229, Wright-Patterson AFB, Ohio
Murufas, P. P., 1426 West 48 St., Los Angeles, Calif.
Nelsen, H. H., 4332 Lafayette, Bellaire, Tex.
Newman, S., 456 Alabama Ave., Brooklyn, N. Y.
Nichols, D. L., R.F.D. 1, Croydon, Pa.
Nicholson, J. K., Box 3432, USAFIT, Wright-Patterson AFB, Ohio
Nielson, W. C., Box 3044, USAFIT, Wright-Patterson AFB, Ohio
Nowakoski, D. B., 11 Maple Ave., Meriden, Conn.
O'Cain, W. L., 512 Amelia, N.E., Orangeburg, S. C.
Ollick, E., Keystone Products Co., 904—23 St., Union City, N. J.
Ormiston, J. W., 255 St. Clarens Ave., Toronto, Ont., Canada
Ostrem, R. E., Box 3241, USAFIT, Wright-Patterson AFB, Ohio
Paulos, P. J., Tinsley's Court, Alamogordo, N. Mex.
Paulson, E. T., 2376 Lake St., Salt Lake City, Utah
Pawlikowski, S. L., 511 Vine St., Emporium, Pa.
Peck, D. B., 10 Haley St., Williamstown, Mass.
Peer, G. C., Apt. 102, 7 St. Lukes Pl., Montclair, N. J.
Perritte, J. L., 1610 Webster St., N.W., Washington, D. C.
Plaisted, A. H., Sylvania Electric Products, Inc., Ipswich, Mass.
Porter, J. R., 251 South E St., Oxnard, Calif.
Purdy, R. L., 89-01—242 St., Bellrose, L. I., N. Y.
Randolph, R. V., 312 Concord Ave., Cambridge, Mass.
Reece, O. A., 1415 Floribunda Ave., Burlingame, Calif.
Reges, A., 3544 Wagner St., Franklin Park, Ill.
Reiffen, B., 34 Fairmont Ave., Southbridge, Mass.
Retzger, L. I., 75-16—199 St., Flushing, L. I., N. Y.
Rhodes, R. D., 815 Huestis Ave., Fort Wayne, Ind.
Rhodes, W. C., Code 125 N, Charleston Navy Shipyard, Charleston, S. C.
Richardson, J. N., 46 Gurley Rd., Nixon, N. J.
Rineer, I., Box 174, Centerville, Ohio
Roberts, L. H., 327 Hoover Ave., Akron 12, Ohio
Robertson, L. C., Box 3258, USAFIT, Wright-Patterson AFB, Ohio
Rosebrugh, R. K., 426 Claremont Ave., Buffalo 23, N. Y.
Runyon, J. P., Bell Telephone Laboratories, Inc., Murray Hill, N. J.
Russell, L., Andrew Alford Consulting Engineers, 299 Atlantic Ave., Boston, Mass.
Ryall, R. W., 848 William St., Montreal, Que., Canada
Sackett, W. T., Jr., 2429 Mecca Rd., Columgus 11, Ohio
Salij, Z. B., 1198 Pacific St., Brooklyn, N. Y.
Sarwari, M. A., 14 Hall Rd., Lahore, Pakistan
Saudinaitis, E., 2737 Hirsch St., Chicago 22, Ill.
Sauer, W. F., 1735 'C' Ave., N. E., Cedar Rapids, Iowa
Schauwecker, H. E., 7 Beekman Rd., Summit, N. J.
Schmitt, E. J., 231-C Garfield Ave., Collingswood 7, N. J.
Seale, C. L., Battelle Memorial Institute, 505 W. King Ave., Columbus, Ohio
Sherman, M. R., 2039 Homecrest Ave., Brooklyn, N. Y.
Silverman, J. B., 7972 Thouron Ave., Philadelphia, Pa.
Sims, B. S., 75-B Readville St., Hyde Park 36, Mass.
Slutz, R. J., 2612 Henderson Ave., Wheaton, Md.
Sodaro, J. A., 8 Carolyn Ave., North Valley Stream, L. I., N. Y.
Soper, G. T., 140 S. Liberty St., Elgin, Ill.
Stanverman, R. J., 1024 W. Irving Park Rd., Chicago 13, Ill.

(Continued on page 264A)

American Beauty

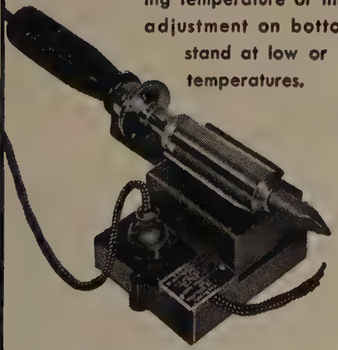
ELECTRIC SOLDERING IRONS

are sturdily built for the hard usage of industrial service. Have plug type tips and are constructed on the unit system with each vital part, such as heating element, easily removable and replaceable. In 5 sizes, from 50 watts to 550 watts.

●

TEMPERATURE REGULATING STAND

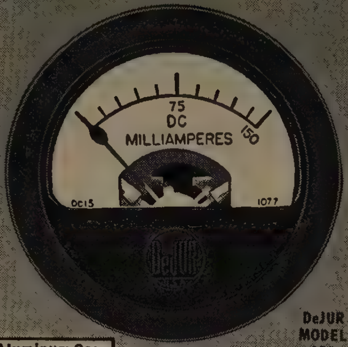
This is a thermostatically controlled device for the regulation of the temperature of an electric soldering iron. When placed on and connected to this stand, iron may be maintained at working temperature or through adjustment on bottom of stand at low or warm temperatures.



For further information or descriptive literature, write

AMERICAN ELECTRICAL HEATER COMPANY
DETROIT 2, MICH., U. S. A.
106

DeJUR



DeJUR MODEL 120

Aluminum Case
•
One Hole Ring Mounting

- DC VOLTMETERS
- AMMETERS
- MILLIVOLT METERS
- MILLIAMMETERS
- AC RECTIFIER TYPES (self-contained).

1½" *Panel* INSTRUMENTS

Precision built DeJUR 1½" instruments for applications where space must be conserved. DeJUR rugged construction. Both models in all ranges and sensitivities. External shunts and multipliers available for various ranges. Complete magnetic shielding and methods of lighting scales. Built to meet government specifications.

ACTUAL SIZE

DeJUR MODEL 112

Also available • 2½" • 3½" • 4" panel meters in all standard ranges. MIL-M-6A and A. S. A.
REQUEST CATALOG P-3

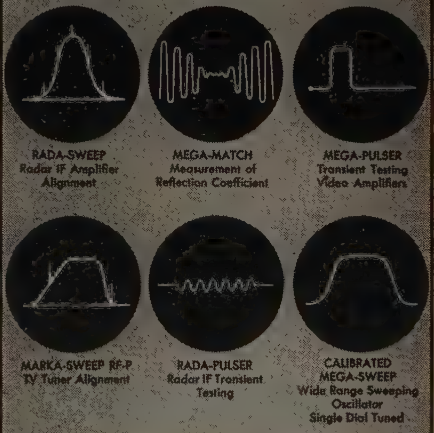
DeJUR USA DeJUR **AMSCO CORPORATION**
45-01 NORTHERN BOULEVARD, L. I. C. 1, N. Y.
MANUFACTURERS OF SCIENTIFIC PRECISION EQUIPMENT FOR OVER A QUARTER OF A CENTURY
• CAMERAS • PROJECTORS • ENLARGERS • EXPOSURE METERS •

ZOPHAR
---WAXES
---COMPOUNDS

Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types; radio, television, etc. Cold flows from 100°F. to 285°F. Special waxes non-cracking at —76°F. Compounds meeting Government specifications plain or fungus resistant. Let us help you with your engineering problems.

ZOPHAR MILLS · QUALITY · SERVICE · 107 YEARS · EXPERIENCE
ZOPHAR MILLS, INC.
112-130 26th Street,
Brooklyn 32, N. Y.

NEED INSTRUMENTS TO SOLVE ELECTRONIC PROBLEMS?...



RADA-SWEEP
Radar IF Amplifier Alignment

MEGA-MATCH
Measurement of Reflection Coefficient

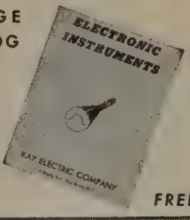
MEGA-PULSER
Transient Testing Video Amplifiers

MARKA-SWEEP RF-P
TV Tuner Alignment

RADA-PULSER
Radar IF Transient Testing

CALIBRATED MEGA-SWEEP
Wide Range Sweeping Oscillator
Single Dial Tuned

CONSULT THIS LATEST 64-PAGE CATALOG



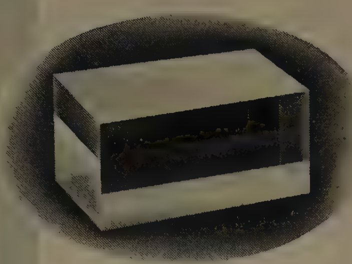
Write FREE

KAY ELECTRIC CO.
14 MAPLE AVE. PINE BROOK, N. J.

THERMO PLASTICS

...from the most complex part
...to the complete product!

NO MATTER how complex the problem, Scheidl has the skilled craftsmen and the equipment to do the job . . . and do it right. Why not visit them at booth 4-416 at the I.R.E. Show and learn more about the facilities of this fast growing fabricator of thermo plastics.



- PANEL AND CONTROL BOX ASSEMBLIES
- MACHINE DETAILS
- EDGLIGHT PANELS MADE TO MIL-P-7788 SPECIFICATIONS
- REINFORCED PLASTIC HOUSINGS FOR ELECTRICAL UNITS
- LOW PRESSURE LAMINATING
- PRECISION AND VACUUM FORMING

SCHEIDL
MANUFACTURING CO.
1985 GREAT NECK RD., COPIAGUE, L. I., N. Y.

HIGH TENSION DC SUPPLIES

- Fine Regulation
- Low Ripple
- Safety

DESIGNED FOR RELIABLE SERVICE IN LABORATORIES AND INDUSTRIAL APPLICATIONS

Model	Voltage Range	Current Range	Regulation
21M	1 - 15 KV	6 ma. @ 10 KV	....
21MR	1 - 15 KV	6 ma. @ 10 KV	.5%
22C	3 - 26 KV	2 ma. @ 18 KV	....
22CR	3 - 26 KV	2 ma. @ 18 KV	.5%
22M	3 - 26 KV	3 ma. @ 20 KV	....
22MR	3 - 26 KV	3 ma. @ 20 KV	.5%
23C	5 - 40 KV	1.3 ma. @ 25 KV	....
23CR	5 - 40 KV	1.3 ma. @ 25 KV	.5%
23M	5 - 45 KV	1.5 ma. @ 30 KV	....
23MR	5 - 45 KV	1.5 ma. @ 30 KV	.5%
24C	5 - 50 KV	1 ma. @ 35 KV	....
24CR	5 - 50 KV	1 ma. @ 35 KV	.5%
24M	5 - 55 KV	2 ma. @ 30 KV	....
24MR	5 - 55 KV	2 ma. @ 30 KV	.5%
33S	1 - 30 KV	4.5 ma. Entire Range	....
33HRR	1 - 30 KV	5 ma. Entire Range	0.1%

REVERSIBLE POLARITY

All units housed in standard 19 inch rack cabinets

NEUTRONIC ASSOCIATES
CONTROL DEVICES

HIckory 6-5013
83-56 VIETOR AVENUE • ELMHURST 73, L.I., N.Y.

MEMBERSHIP

(Continued from page 262A)

Stietenroth, J. D., 4877 Maplewood Dr., Jackson Miss.
Stucky, N. P., 2835 Nicollet Ave., Minneapolis 8, Minn.
Sumner, T. B., 6050 Cartwright Ave., North Hollywood, Calif.
Suozzi, J. J., Bldg. 24–5, Naval Ordnance Laboratory, White Oak, Md.
Thompson, R. E., 424 Stambaugh St., Redwood City, Calif.
Thormahlen, W. H., 1044 Berkeley Ave., Menlo Park, Calif.
Thorp, H. R., Box 3285, USAFIT, Wright-Patterson AFB, Ohio
Trigg, R. J., 47 Elthorne Park Rd., London W. 7, England
Vidalis, D., 90 Admiral Betty, Pierous, Greece
Wackid, C. B., 281 Laurier West, Ottawa, Ont., Canada
Walker, J. R., 285 Pleasant St., Winthrop 52, Mass.
Wels, B. G., 115 Abbey La., Levittown, L. I., N. Y.
Whalen, R. J., 25 Greenbush Dr., Poughkeepsie, N. Y.
Wheeler, R. W., 1014 Frances Ave., La Habra, Calif.
Whipple, M. M., 700 Delay Dr., Eugene, Ore.
Wiles, Q. T., 112 W. First St., Ogallala, Nebr.
Williams, L. D., 1800 AACS Wing, Tinker AFB, Okla.
Wingard, C. G., 694 N. Park Ave., Pomona, Calif.
Witkowski, A. J., Jr., 6 Norfolk St., Hartford, Conn.
Wolff, G., 55 Gateway, Rockville Center, L. I., N. Y.
Woolley, P. V., 2406 Lake Ave., Cheverly, Md.
Wurthmann, G. E., 169 Main St., Matawan, N. J.
Young, J. K., Box 3402, USAFIT, Wright-Patterson AFB, Ohio
Young, K. A., 1002 Inspector General, GP, Norton AFB, Calif.
Zieger, J. A., Box 864, Denville, N. J.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

Power Supply

The Type 200 Low-Voltage Power Supply, a highly regulated unit for use with resistance strain-gage elements, and for similar exacting applications has been developed by **Owen Labs.**, 9130 Orion Ave., San Fernando, Calif.

Output is 1 ampere maximum, at from zero to 15 volts dc. Where absolute freedom from drift is required, a small chopper-amplifier provides precise stabilization against an external reference. The supply may be rack mounted.

(Continued on page 265A)

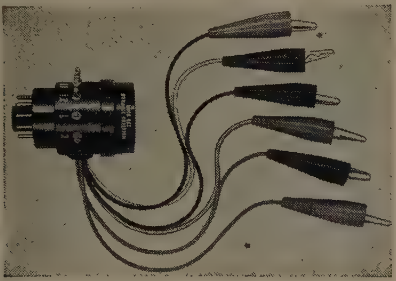
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 264A)

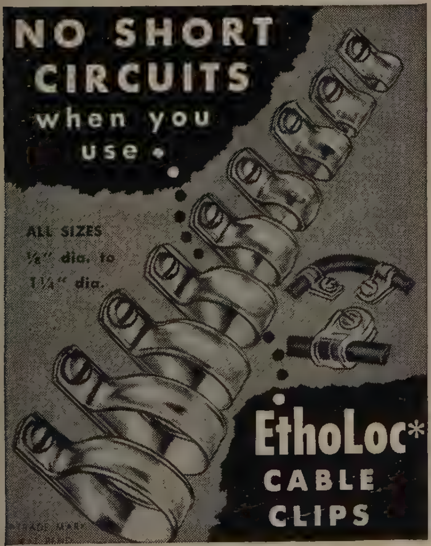
CRT Dynamic Analyzer

Electronic Beam Corp., 923 Old Nepperhan Ave., Yonkers 3, N. Y., announces the production of their new CRT Dynamic Analyzer which attaches to any VTVM and converts it into a CRT tester. According to the manufacturer, it is the only instrument that checks both set and tubes under actual operation.



The instrument checks all socket voltages of a TV set while in operation, and checks emission of the CR Tube and gives the related emission reading. (The related emission reading is the only reliable one that eliminates the errors encounted with readings on other type testers.) It also checks CR Tubes for open and shorted elements, and leakage.

(Continued on page 268A)



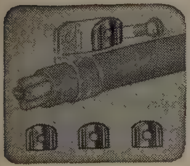
NO SHORT CIRCUITS when you use

ALL SIZES ⅛" dia. to 1¼" dia.

EthoLoc* CABLE CLIPS

TRADE MARK

Made of ETHYL CELLULOSE . . .
A TOUGH, DURABLE PLASTIC



NOW . . .
For Extra Strength
"D" WASHERS
TO FIT OUR
CABLE CLIPS

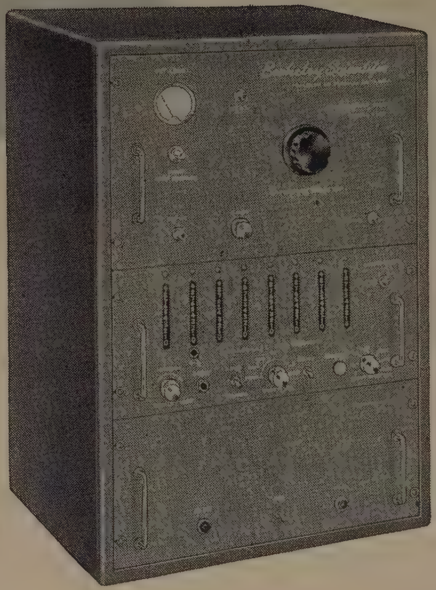
Write for Sample and Full Information

ALSO MFRS. OF ALL NYLON CABLE CLIPS

WECKESSER CO.
5269 N. AVONDALE AVE. • CHICAGO 30, ILL.
West Coast Representative:
5777 West Pico Blvd. • Los Angeles 19, Calif.

BERKELEY announces

another "First". . .
a direct reading digital
0-42 megacycle
frequency meter
MODEL 5570



✱ Accuracy: 1 part in 10^7, ±1 count

✱ Direct-reading digital indication

✱ A complete instrument in one package.

Wide Application . . . transmitter frequency monitoring, crystal checking, general laboratory and production line use wherever rapid, precise frequency determination is desired.

On Display at the IRE Show, New York
March 23-26—Booths 302 and 304, Fourth Floor

M-6

Berkeley Scientific
division of BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVENUE • RICHMOND, CALIFORNIA

"DIRECT READING DIGITAL PRESENTATION OF INFORMATION"

COMMUNICATIONS EQUIPMENT CO.

PULSE TRANSFORMERS

D-166173: Video, Ratio = 50:900 Ohms 10KC—2MC $12.50
G.E.K.-2745 ....$39.50
G.E.K.-2744-A, 11.5 KV High voltage. 3.2 KV Low voltage @ 200 KW oper. (270 KW max.) 1 microsec. or 1/microsec. @ 600 PPS $39.50
W.E. D169271 Hi Volt Input pulse Transformer ..$27.50
G.E. K2450A. Will receive 13KV, 4 micro-second pulse on pri. secondary delivers 14KV. Peak power out 100 KW G. E. $34.50
G. E. K2748A. Pulse Input line to magnetron $36.00
Ray UX 7896—Pulse Output Pri. 5v. sec. 41v ..$7.50
Ray UX 8442—Pulse inversion—40v + 40v $7.50
Ray UX 7361 ....$5.00
PHILCO 352-7250, 352-7251, 352-7287
UTAH 9332, 9278, 9341.
RAYTHEON: UX8693, UX5986 ....$5 ea.
W.E.: D-166310, D-16638, KS 9800, KS9948

PULSE EQUIPMENT

APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk. Pwr. out 35 KW Energy 0.018 Joules $49.00

TPS-3 PULSE MODULATOR. Pk. power 50 amp. 24 KW (1200 KW pk): pulse rate 200 PPS. 1.5 microsec. pulse line impedance 50 ohms. Circuit series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New with all tubes $49.50

DELAY LINES

D-168184: 0.5 microsec. up to 2000 PPS 1800 ohm term $4.00
D-170499: 25/.50/.75 microsec. 8 KV 50 ohms imp. $16.50
D-165997: 1¼ microsec. $7.50
RCA 255686-502, 2.2μ sec. 1400 ohms $2.00

PULSE NETWORKS

G.E. #6E3-5-2000-50P2T. 6KV "E" circuit, 3 sections .5 microsecond. 2000 PPS 50 ohms impedance $6.50
15A—1-400-50: 15 KV, "A" CKT. 1 microsec. 400 PPS. 50 ohms imp. $37.50
G.E. #3E (3-84-810) 8-2.24-405) 50P4T; 3KV "E" CKT Dual Unit; Unit 1, 3 sections, 0.84 Microsec. 810 PPS, 50 ohms imp.: Unit 2, 8 Sections, 2.24 microsec. 405 PPS. 50 ohms imp. $6.50
7-5E3-1-200-67P. 7.5 KV "E" Circuit, 1 microsec 200 PPS. 67 ohms impedance 3 sections $7.50
7-5E4-16-60, 67P. 7.5 KV. "E" Circuit, 4 sections 16 microsec. 60 PPS. 67 ohms impedance $15.00
7.5E3-3-200-6FT, 7.5 KV. "E" Circuit, 3 microsec. 200 PPS. 6 ohms imp. 3 sections $12.50
#755: 10KV, 2.2usec., 375 PPS. 50 ohms imp. ..$27.50
#754: 10KV. 0.85usec., 750 PPS. 50 ohms imp. ..$27.50
KS8865 CHARGING CHOKE: 115-150H @ .02A, 32-40H @ .08A, 30,700V Corona Test, 21KV Test $37.50
G.E. 25E5-1-350-50 P2T. "E" CKT, 1 Microsec. Pulse @ 350 PPS. 50 OHMS Impedance $69.50

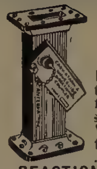
400 CYCLE TRANSFORMERS

(All Primaries 115V, 400 Cycles)

Stock	Ratings	Price
M-7467886	2X140V/.014A, 120V/.012A, 1200 VRMS TEST, P/O MX-8/APG-2	$ 4.95
352-7102	6.3V/2.5A	1.45
M-7472426	1450V/ MA, 2.5V/.75A, 6.4V/3.9A, 5V/2A, 6.5V/.3A, P/O ID-39/APG-13	4.95
352-7039	640VCT @ 250MA, 6.3V/.9A, 6.3V/6A, 5V/6A	$5.49
702724	9800/8600 @ 32MA	8.95
K59584	5000V/290MA, 5V/10A	22.50
52J652	13,500V/3.5MA	14.65
KS9607	734VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V/0.9A, 6.3V 2.5A 6.3V/.06A, 5V/CA	6.95
352-7070	2X2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/1000/75 OV @ .005A	7.45
352-7196	1140V/1.25MA, 2.5V/1.75A, 2.5V/ 1.75A —5KV Test	3.95
352-7176	320VCT/50MA, 4.5V/3A, 6.3VCT/20A, 2X6.3VCT/6A	4.75
RA6400-1	2.5V/1.75A, 6.3V/2A—5KV Test	2.39
901692	13V 9A	2.49
901699-501	2.77V @ 4.25A	3.45
901698-501	900V/75MA, 100V/.04A	4.29
UX8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/80MA, 5V/3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300 VCT, 135MA	5.95
KS 9336	1100V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/21A	4.25
KS 8984	27V/4.3A, 6.3/2.9A, 1.25V/.02A	2.95
52C080	526VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
68G631	1150-0-1150V	2.75
80G198	6VCT/.00006 KVA	1.75
302433A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5V/3.5A	4.85
KS 9445	592VCT/118MA, 6.3V/8.1A, 5V/2A	5.39
KS 9685	6.4/7.5A, 6.4V/3.8A, 6.4V/2.5A ALL CT	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95

MICROWAVE COMPONENTS

S BAND—3" x 1½" WAVEGUIDE



DIRECTIONAL COUPLER, Broadband type "N" Coupling. 20 db. with std. flanges. Navy #CABV 47AAN-2. As shown $37.50
WAVEMETER, 2700-3400 MC, Reaction type with counter Dial—Mfg., W.E. $92.50
REACTION WAVEMETER, Mfg. G.E. 3000-3700 MC. Mic Head $125.00
LHTR. LIGHTHOUSE ASSEMBLY. Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG, To Recvr. Uses 2C40, 2C43, 1B27, Tunable APX 2400-2700 MCS, Silver Plated $49.50
BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice, each $47.50
MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated $45.00
RT-39 APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr-TR, cavity compl. recvr. & 30 MC IF strip using 60K5 (2C40, 2C43, 1B27 lineup) w/Tubes.
721A TR BOX complete with tube and tuning plungers $12.50
McNALLY KLYSTRON CAVITIES for 707B or 2K28 ....$4.00
F 29 SPR-2 FILTERS, type "N" input and output $12.50
WAVEGUIDE TO ⅞" RIGID COAX "DOORKNOB" ADAPTER CHOKE FLANGE, SILVER PLATED BROAD BAND $32.50
AS14A AP-10 CM Pick up Dipole with "N" Cables $4.50
OAJ ECHO BOX, 10 CM TUNABLE $22.50
HOMERELL-TO-TYPE "N" Male Adapters. W.E. #D167284 ....$2.75
I. F. AMP. STRIP: 30 MC. 120 d.b. gain, 2 MC Bandwidth, uses 6AC7's—with video detector. Less tubes $24.50
POLYROD ANTENNA, AS31/APN-7 in Lucite Ball. Type "N" feed $22.50
ANTENNA, AT49A/APR: Broadband Conical. 300-3300 MC Type "N" Feed $12.50
"E" or "H" PLANE BENDS. 90 Deg. less flanges $7.50

⅞" RIGID COAX—⅜" I.C.

RIGHT ANGLE BEND, with flexible coax output pickup loop $8.00
SHORT RIGHT ANGLE BEND, with pressurizing nipple $3.00
RIGID COAX to flex coax connector $3.50
RT. ANGLES for above $2.50
RT. ANGLE BEND 15" L. OA $3.50
FLEXIBLE SECTION. 15" L. Male to female $4.25
⅞" RIGID COAX. BULKHEAD FEED-THRU $14.00

⅞" RIGID COAX—⅜" I. C.

ROTARY JOINT. Stub-supported, UG 46/UG 45 fittings $27.50
10 CM STABILIZER Cavity, tunable, standard UG46/UP 45 fittings $45.00
RG 44/U RIGID COAX, stub support, 5 ft. sections, with UG46/UG45 connectors $12.50
RIGHT ANGLE BEND, with flexible coax output pickup loop $8.00
SHORT RIGHT ANGLE BEND, with pressurizing nipple $3.00
RIGID COAX to flex coax connector $3.50
RT ANGLES for above $2.50
RT. ANGLE BEND 15" L. OA $3.50
FLEXIBLE SECTION, 15 L. Male to female. .$4.25
⅞" RIGID COAX. BULKHEAD FEED-THRU $14.00

X BAND—1" x ½" WAVEGUIDE

1" x ½" waveguide in 5' lengths, UG 39 flange to UG40 cover ....**per length $7.50**
Rotating joints supplied either with or without deck mounting. With UG40 flanges ....**each, $17.50**
Bulkhead Feed-thru Assembly $15.00
Pressure Gauge Section 15 lb. gauge and press nipple $10.00
Pressure Gauge, 15 lbs. $2.50
Directional Coupler, UG-40/U Take off 20 db. $17.50
TR-ATR Uuplexor section for above $8.50
Waveguide Section 12" long choke to cover 45 deg. twist & 2½" radius. 90 deg. bend $4.50
Twist 90 deg. 5" choke to cover w/pres nipple $6.50
Waveguide Section 2½ ft. long silver plated with choke flange $5.75
Rotary joint choke to choke with deck mounting $17.50
3 cm. mitered elbow "E" plane $12.00
UG 39 Flanges ....$ .85
90 degree elbows. "E" or "H" plane 2½" radius $12.50
90 degree twist 6" long $8.00
45 degree twist $8.00
Microwave Receiver, 3 CM. Sensitivity: 10-13 Watts. Complete with L.O. and AFC Mixer and Waveguide Input Circuits. 6 I.F. Stages give approximately 120 DB gain at a bandwidth of 1.7 MC. Video Bandwidth: 2 MC. Uses latest type AFC circuit. Complete with all tubes, including 723A/B Local Oscilator $175.00

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps Input

CTJ5-2-600VCT/.2A, 5V/CA				$5.95
CT-15A	550VCT	.085A	6.3V/.6A, 6.3V/1.8A	2.85
CT-164	4200V.002A/12KV Test, 5VCT/3A/12KV Test, 6.3V/0.6A/5400 V Test			12.95
CT-341	1050V/10MA,—625V @ 5 MA, 26V @ 4.5A 2x2.5V/3A, 6.3V @ 3A			16.95
CT-825	360VCT	.340A	6.3VCT/3.6, 6.3VCT/3A	3.95
CT-626	1500V	.160A	2.5/12, 30/.100	9.95
CT-071	110V	.200A	33/.200, 5V/10, 2.5/10	4.95
CT-367	580VCT	.050A	5VCT/3A	2.25
CT-99A	2x110VCT	.010A	6.3/1A, 2.5VCT/7A.	3.25
CT-403	350VCT	.026A	5V/3A	2.75
CT-931	585VCT	.086A	5V/3A, 6.3V/6A	4.25
CT-610	1250	.002A	2.5V/2.1A, 2.5V/1.75A	4.95
CT-456	390VCT	80MA	6.3V/1,3A, 5V/3A	3.45
CT-160	800VCT	100MA	6.3V/1,2A, 5V/3A	4.95
CT-931	585VCT	86MA	5V/3A, 6.3V/6A	4.95
CT-442	525VCT	75MA	5V/2A, 10VCT/2A, 50V/200MA	3.85
CT-720	550-0-550V/250MA, 6.3V/1.8A			8.95
CT-43A	600-0-600V/.08A, 2.5VCT/6A, 6.3VCT/1A			6.49
CT7-501	650VCT/200MA, 6.3V/5A			6.49
CT-444	230-0-230V/.085A, 5V/3A, 6V/2.5A			3.49

Filament Transformers—115V/50-60 cps input

Item	Rating	Each
FT-674	8.1V/1.5A	$ 1.10
FT-157	4V/16A,2.5V/1.75A	2.95
FT-101	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	14.95
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A. 6.4V/2A	8.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V/3A	8.95
FT-986	16V @ 4.5A or 12V @ 4.5A	3.75
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A, TAP 2.5V/2.5A, 16KV TEST	18.95
FT-608	6.3V/3A/750V Test	1.79
FT-873	4.5V/.5A, 7V/7A	2.19
FT-899	2x5V @ 5A, 29KV Test	24.50

Plate Trans.—115V, 60 cps

Item	Rating	Price
PT-446	18.5V3.5A	$4.59
PT-699	300/150V/.05A, 300/150V/.05A	2.79
PT.302	120-0-120V/350MA	4.69
PT-671	62V/3.5A	7.95

Special Fil. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STF-370	220/440	3x2.5V/5A, 3KV Test 2.5V/15A	$ 6.95
STF-11A	220V	2x40V/.05A, 2x5V/6A 12.6V/1A	4.49
STF-608	220V	24V/0.6A, 5V/3A, 6.3V/1A, 6.3V/1A	3.45
STF-968	230V	2.5V/6.5A	3.50
STF-631	230V	2x5V/27A, 2x5V/9A	17.59

THERMISTORS VARISTORS

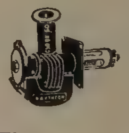
D167018	$1.50	D171812	$1.50
D167332	1.50	D172155	1.50
D167613	1.50	D167176	1.50
D166228	1.50	D168687	1.50
D164699	2.50	D167208E, D171858	1.50
D163903	1.95	308A, 27-B	1.50
D166792	2.15	D168403	2.15

FILTER CHOKES

Stock	Description	Price
CH-366	20H/.3A	$ 6.95
CH-322	.35H/350 MA—10 Ohms DCR	2.75
CH-141	Dual 7H/75MA, 11H/60 MA 5KV DC Test	4.69
CH-119	8.5H/125 MA	2.79
CH-69-1	Dual: 120H/17 MA	2.35
CH-8-28	2 x .5H/380 MA/25 Ohms	1.79
	DCR. 1 KV TEST	2.95
CH-776	1.28H/130 MA 75 ohms	2.25
CH-344	1.5H/145MA/1200V Test	2.35
CH-43A	10HY/15MA—850 ohms DCR	1.75
CH-917	10H, 450MA, 10KV TEST	12.95
CH-366	20H/300MA	6.95
CH-999	15HY/15MA—400 ohms DCR	1.95
CH-511	6H/80MA—310 ohms DCH	2.45
CH3-501	2 x .5HY/400MA	2.79
CH-188M	5HY 200MA	1.79
CH-488	10HY .030A	1.19
CH-791	Dual 1.75-.125 HY 100 MA	1.27
CH-981	15 HY .110A	1.59
CH-22-1	1 HY .100A	1.17
CH-779	.6HY .490A	1.25
CH-25A	SW .09/.018 HY 3/.3A	8.95
CH-922	10000 HY 0 MA	2.75
CH-043	2.2 HY 80 MA	.98
CH-89A	2 x 1.52H @ .167A	1.39
CH-303	300H/.02A, 2500V Test	1.69
CH-932	SWING 9-60H/.4-.05A, 10KV	7.95
CH-445	0.5 HY/200 MA, 32.2 OHMS, 3000V.T.	1.39
CH-170	2X0.5H/380 MA, 25 OHMS	2.79
CH-533	13.5H, 1.0 AMP DC, 13.5KV INS.	39.95

MAGNETRONS

Tube	Tube	Tube
2J27	2J49	718DY
2J31	2J56	720BY
2J21	2J61	725-A
2J22	700	730-A
2J26	706	QK 62
2J32	2J62	QK 61
2J38	3J31	QK 60
2J39	5J30	



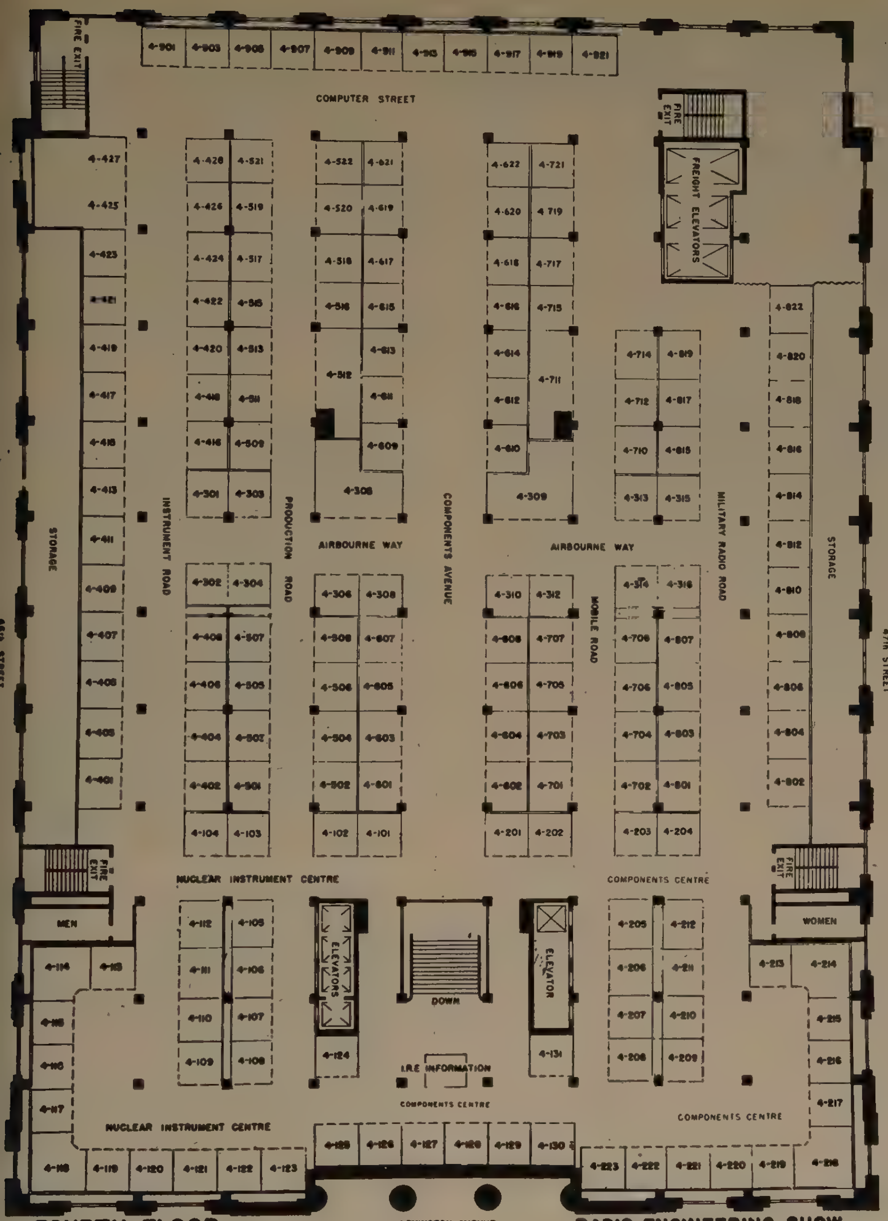
MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P.O. ALL MDSE. SUBJECT TO PRIOR SALE, AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

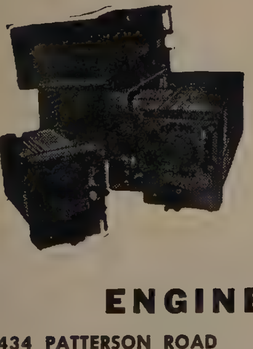
PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK OR RAILEX.

131 Liberty St., New York 7, N. Y. Dept I-3 Chas. Rosen Phone: Digby 9-4124

What to see at the Radio Engineering Show

(Continued from page 246A)





AN/APR-4 LABORATORY RECEIVERS

Complete with all five Tuning Units, covering the range 38 to 4,000 Mc.; wideband discone and other antennas, wavetraps, mobile accessories, 100 page technical manual, etc. Versatile, accurate, compact—the aristocrat of lab receivers in this range. Write for data sheet and quotations.

We have a large variety of other hard-to-get equipment, including microwave, aircraft, communications, radar; and laboratory electronics of all kinds. Quality standards maintained. Get our quotations!

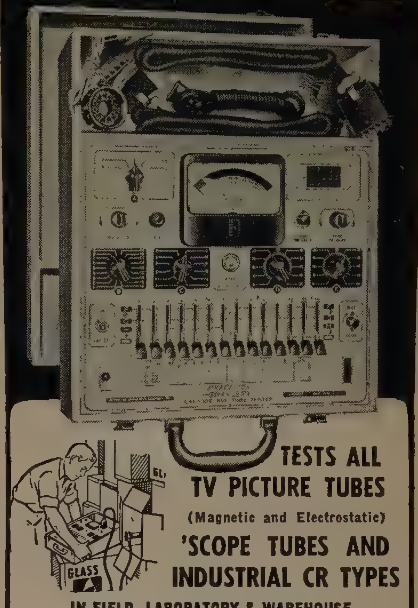
We will buy any Electronic Material at top prices. SCHOOLS—unload your dusty surplus for cash or credit.

ENGINEERING ASSOCIATES

434 PATTERSON ROAD
DAYTON 9, OHIO

PRECISION

CATHODE RAY TUBE TESTER SERIES CR-30



TESTS ALL TV PICTURE TUBES
(Magnetic and Electrostatic)
'SCOPE TUBES AND INDUSTRIAL CR TYPES

IN FIELD, LABORATORY & WAREHOUSE
without removal from chassis or carton!

A complete and self-contained Electronic Instrument. Incorporates a TRUE BEAM CURRENT Test Circuit. Checks overall electron-gun performance for proportionate picture brightness. Additional tests for accelerating anodes and deflection plate elements.

The Precision CR-30 should not be confused with mere adapters connecting to ordinary receiving tube testers which were never designed to meet the very specialized needs of CR tube checking. Similarly, it is not to be confused with neon-lamp units or similar devices of limited technical merit and which do not check all CR tubes or all tube elements.

SPECIFICATIONS

★ **Tests All Modern Cathode Ray Tubes. Tests All CR Tube Elements:** Not just a limited few.

★ **Free-Point 14 Lever Element Selection System,** for all Short-Check, Leakage Testing and Quality Tests.

★ **True Beam Current Test Circuit** checks all CR Tubes with Electron-gun in operation. It is the **Electron Beam** (and NOT total cathode emission) which traces the pattern on the face of the CR tube. The significance of the above rests in the fact that Beam Current (and picture brightness) is primarily associated with the condition of the **center** of the cathode surface and not the overall cathode area.

★ **Voltage Regulated, Bridge Type VTVM** affords supersensitive tube quality indications and positive check of low current anodes and deflection plates.

★ **Micro-Line Voltage Adjustment, Meter-monitored.**

★ **Accuracy** of test circuits closely maintained by use of factory adjusted internal calibrating controls; plastic insulated, telephone type cabled wiring; highest quality, conservatively rated components.

★ **Built In, High Speed, Roller Tube Chart.**

★ **Test Circuits** Transformer Isolated from Power Line.

★ **4⅝" Full Vision Meter** with scale-plate especially designed for CR tube testing requirements.

SERIES CR-30 — In hardwood, tapered portable case. 17¼" x 13¾" x 6¾". Complete with standard duo-decal cable and universal CR Tube Test Cable.

Shipping Weight: 22 lbs.......................Net Price: $99.75

See the Series CR-30 on display at leading electronic equipment distributors.

PRECISION APPARATUS CO. INC.
92-27 HORACE HARDING BLVD., ELMHURST 12, N. Y.
Export: 458 B'way, N. Y. C., U.S.A. Cables: MORHANEX
In Canada: Atlas Radio Corp. Ltd., Toronto, Ontario

Timely
McGRAW-HILL BOOKS

✓ CHECK
these 7 volumes—
see any that interest you
10 days free

Just Published!
INSTRUMENT ENGINEERING
By C. S. DRAPER, W. McKAY, and S. LEES
The Massachusetts Institute of Technology

VOLUME I—METHODS FOR DESCRIBING THE SITUATIONS OF INSTRUMENT ENGINEERING

1. **This first volume** of a three-volume work develops a broadly useful system of concepts, notations, diagrams, and mathematical forms for describing the performance of physical devices and variations in physical qualities. It lays a foundation for the solution of problems by *instrument systems* rather than *design details*. Any problem may be handled by the generalized pattern outlined, or it may be handled with the names and notations ordinarily used by workers in the fields of engineering in which they occur. Contributions come to the book from the various fields of mathematics, physics, and engineering. **269 pages, 8½ x 11, 93 illus. $6.00**

To be followed soon by . . .

VOLUME II—MATHEMATICAL FUNDAMENTALS

2. **Reviews the mathematical background** of several methods for associating solutions with these descriptive forms and illustrates procedures by actual derivations of quantitative results for a number of generally used examples. **Approximately same size as Volume I. About $6.00.**

VOLUME III—APPLICATIONS

3. **This volume is made up of examples** that use the materials of Volumes I and II for representing instrument engineering situations and finding solutions for the mathematical forms involved. In each example, the physical interpretation of the solutions is discussed in terms of the important factors of the original problem. **Approximately same size as Volume I. About $6.00.**

ELECTRON TUBES IN INDUSTRY

4. **Tells how the electron tube** makes industrial processes simple, cheaper, safer. Explains operating principles of components, tubes, and circuits, applied to industrial problems of control, measurement, electronic heating, motor speed control. Describes amplifiers, thyratrons, phototubes, and cathode-ray tubes and applications. **By K. Henney, Editorial Director, and J. D. Fahnestock, Assoc. Editor,** ***Electronics,*** **3rd Ed. 347 pages, 234 illus. $6.00**

ANALYSIS OF ALTERNATING CURRENT CIRCUITS

5. **Here's a modern introduction to a-c circuits** completely devoted to the steady state in lumped linear networks. Notations for potential differences follow newly recommended practices, and the two dimensional quantities used in network analysis likewise are in accord with the latest trends. **By W. R. LePage, Prof. of Elec. Engr., Syracuse University. 444 pages, 520 illus., $6.50.**

ELECTRONIC ANALOG COMPUTORS

6. Gives aid on the design and application of electronic computors of the d-c analog type, including repetitive computors, used as differential analyzers and equation solvers. **By G. A. Korn, Staff Engr., Lockheed Aircraft Corp., and Theresa M. Korn, formerly Engr., Boeing Aircraft Co. 378 pages, 70 illus., $7.00.**

MUSICAL ENGINEERING

7. **The first unified treatment** from an engineering viewpoint on all the elements that enter into the production and reproduction of music. Covers the nature of sound, music, musical instruments, acoustics, and hearing in both their physical and some of their psychological aspects. **By H. F. Olson, Dir. Acoustical Laboratory, RCA Labs. 369 pages, 303 illus., 28 tables, $7.00.**

MAIL THIS CONVENIENT COUPON TODAY

McGraw-Hill Book Co., Dept. IRE 53
327 W. 41st St., N.Y.C. (36)

Send me the book(s) circled to the right for 10 days examination on approval. In 10 days I will remit the price of the books I wish to keep, plus a few cents for delivery and return unwanted books postpaid. (We pay delivery charge if you remit with this coupon. Same return privilege.)

1. 2. 3. 4. 5. 6. 7.

(Print)
Name ....
Address ....
City ....Zone ...... State......
Company ....
Position IRE-53
This offer applies to U.S. only.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 265A)

Frequency-Timing-Counting Equipment

With the introduction of four new models, a very complete line of frequency-counting equipment is announced by the **Potter Instrument Company, Inc.,** 115 Cutter Mill Road, Great Neck, L. I., N. Y.

The Model 820 and 830 Frequency Counters suit the production line and are useful for calibrating oscillators, for measurement of flow and pressure with appropriate pickup device, and for obtaining rpm data on engine test stands, among other applications.

Much greater versatility is featured in the Model 840 and 850 Frequency-Time-Counters, which contain all the timing, gating and switching facility necessary for the widest possible range of measurement functions. These include direct counting of frequencies up to 1 mc or timing the period of a cycle with 10 μsec. Elapsed time is measurable in increments variable from 10 μsec up to one second. Two unknown frequencies can be compared to obtain a ratio or an external standard introduced for a higher accuracy time base. For use as a secondary frequency standard outputs are provided from a divider at 100 kc, 10 kc, 1 kc, 100 cps, 10 cps and 1 cps.

Plant Expansion

Dorne and Margolin, 30 Sylvester St., Westbury, L. I., N. Y., an electronics firm specializing in high-frequency antenna development, have moved to a new and larger plant in Westbury, New York. The new plant was designed to provide expanded research and production facilities. Versatile pattern and impedance-measurement facilities are currently available with particular emphasis on applications for airborne electronics.

(Continued on page 271A)

Call for Papers

For

1953 Western Region IRE Convention

Authors are invited to submit prospective papers for the IRE Convention part of 1953 WESCON (Western Electronic Show & Convention), to be held in San Francisco on August 19, 20 and 21. Papers in the fields of Antennas, Circuits, Communication Theory, Computers, Control and Instrumentation, Electron Devices, Audio, UHF and Microwave Techniques, Nuclear Electronics, Transistors and Non-Vacuum Tube Electronics are of particular interest, but no paper should be withheld merely because it does not fall into one of these categories.

The following information should be submitted: (1) Name, address and affiliation of author, (2) title and 100 word (maximum) abstract as you wish it to appear in the program, and (3) a 500 word summary. The summary (3) will be used to evaluate the paper so be sure that this summary presents clearly the essential new material of the paper.

Please address all communications to B. M. Oliver, c/o Hewlett-Packard Company, 395 Page Mill Road, Palo Alto, California. The deadline for acceptance is May 1, 1953. Earlier submission will insure full consideration of your paper. Do it now!

WESCON

MODEL A-4
TIME DELAY GENERATOR

- A precision device for the generation of accurate and variable time intervals from .00001 to 10 seconds.

Also available:
Model A-2—.8 to 100,000 µs.

Write for complete data:
Our bulletins I-A-4 and I-A-2

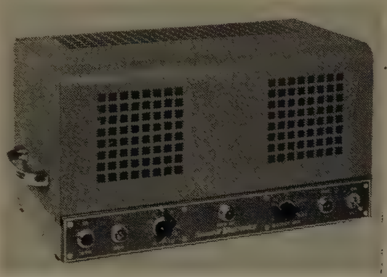
Rutherford
ELECTRONICS CO.
3707 S. ROBERTSON BLVD., CULVER CITY, CALIF.

News—New Products

(Continued from page 268A)

Audio Amplifier

A new precision audio amplifier combining unusually low signal-to-noise and distortion factors with high power output has been announced for laboratory measurement application by **Summit Electronics, Inc.**, 7 Industrial Pl., Summit, N. J. The equipment is available in several models for varying input impedance requirements, while output impedance is switch controlled from 4 to 600 ohms in all models.



Employing negative feedback on all stages, the new amplifier offers extremely stable characteristics. Distortion is less than 1 per cent at the full rated output of 30 watts, while frequency response is exceptionally flat over a 30 cps to 15 kc range; with a high impedance input the response is flat ±0.2 db over the entire range and similarly low variances are encountered when bridging or terminating low impedances are used.

The amplifier is sold only by the manufacturer at a price of $150 f.o.b. with no input transformer. For balanced operation with an input transformer there is an additional charge of $15.00.

Medium-Mu Twin Triode

Tube Dept., Radio Corp. of America, Harrison, N. J., has developed the 6211, a new medium-mu twin triode of the 9-pin miniature type designed especially for frequency-divider circuits in electronic computers and other "on-off" control applications involving long periods of operation under cutoff conditions.

For such control service, the 6211 maintains its emission capabilities even after long periods of operation under cut-off conditions and, therefore, provides good consistency of plate current during its "on" cycles.

The 6211 has separate terminals for each cathode to facilitate flexibility of circuit arrangement, and a mid-tapped heater to permit operation from either a 6.3-volt or 12.6-volt supply. The heater is made of pure tungsten.

(Continued on page 272A)

AIR-SPACED ARTICULATED
CO-AX
CABLES

offer a unique combination of

✓ FRACTIONAL CAPACITANCE
✓ HIGH IMPEDANCE
✓ MINIMUM ATTENUATION
ALONG WITH
✓ EXCEPTIONAL FLEXIBILITY
✓ LIGHT WEIGHT

38 STOCK TYPES
FOR ANY OF YOUR STANDARD OR SPECIAL APPLICATIONS

A few of the very low capacitance types are:

Type No.	*Capacitance µµ F/ft.*	*Impedance ohms*	*O.D.*
C.44	4.1	252	1.03″
C.4	4.6	229	1.03″
C.33	4.8	220	0.64″
C.3	5.4	197	0.64″
C.22	5.5	184	0.44″
C.2	6.3	171	0.44″
C.11	6.3	173	0.36″
C.1	7.3	150	0.36″

WE ARE SPECIALLY ORGANIZED TO HANDLE DIRECT ORDERS OR ENQUIRIES FROM OVERSEAS
SPOT DELIVERIES FOR U.S.
BILLED IN DOLLARS—SETTLEMENT BY YOUR CHECK
CABLE OR AIRMAIL TODAY

TRANSRADIO LTD.
CONTRACTORS TO H.M. GOVERNMENT
138A CROMWELL RD., LONDON, S.W.7
ENGLAND
CABLES: TRANSRAD LONDON

leading users of
STEATITE
insulators
SPECIFY
Thor

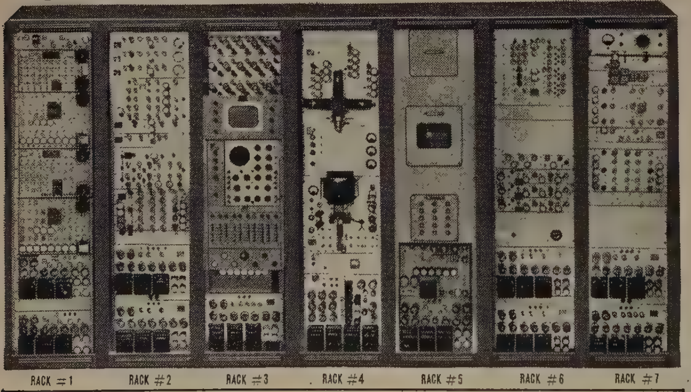
Thor steatite insulators are available as standard or custom-made items to Jan-I-10 or customers' specifications. Specialists in metalizing, and grinding to close tolerances.
Write Dept. R for Details and Catalogs.

Thor Ceramics, Inc.
225 Belleville Avenue Bloomfield New Jersey

VISIT BOOTH 3-409 IRE SHOW, GRAND CENTRAL PALACE

ALL-SYSTEM Color TV 'Colossus'
Another TELECHROME Engineering Achievement

An example of a comprehensive integrated system for transmitting and monitoring self-created as well as remote-origin signals.



RACK #1 — Driving source; produces all pulses: driving, blanking, sync, etc. for RTMA, F.C.C., and NTSC color; includes the subcarrier.

RACK #2—Gamma Amplifiers, color encoders to convert color signals to requirements of specific system under examination.

RACK #3—Distribution, monitoring, and switching panels.

RACK #4 — Contains universal color picture generator with crossed dichroic mirror assembly and scanner tube.

RACK #5 — Universal color monitor with dichroic unit.

RACK #6 — Contains off-the-air T.V. receiver, color bar generator, and three video amplifiers.

RACK #7—Picture (and sound) signal source closely approximating the proper characteristics of T.V. station transmitters; this rack contains also decoders for both NTSC and field sequential rates.

Custom made laboratory-quality instrumentation

• • •

TELECHROME'S color equipment now being used by many of the nation's leading broadcasters, receiver manufacturers and laboratory groups, for establishing standards and for further development in the television color field.

• • •

Let TELECHROME help solve your special design requirements for color and monochrome T.V. Consult freely with our engineering staff now. Phone or write.

COLOR TV TELECHROME INCORPORATED
THROUGH ADVANCED RESEARCH & DEVELOPMENT
88 MERRICK ROAD, AMITYVILLE, N.Y.
TELEPHONE: AMITYVILLE 4-4446

News—New Products

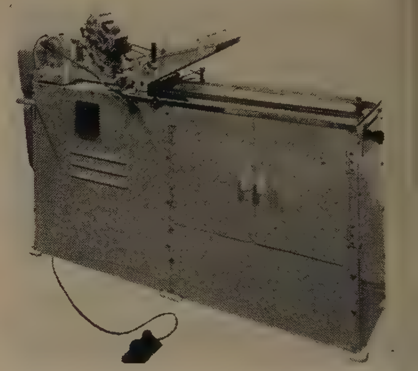
These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 271A)

Marking Machine

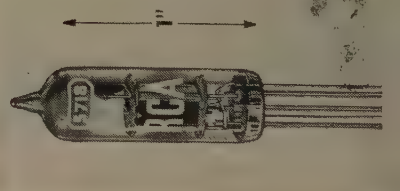
Popper & Sons, Inc., 300 Fourth Ave., New York 10, N. Y., distributors for Rejafix, Ltd., are bringing out the latest model of a fully automatic marking machine.

This machine will print on cylindrical objects such as capacitors, relays, condensers, controls, electronic valves, etc., at a speed of up to 6,000 pieces per hour. Whether the components are made from glass, plastics, metal, or cardboard, etc., the prints will come out with greatest accuracy down to the minutest letterings.



Other Rejafix models will handle objects regardless of shape, whether they are round, tapered, rectangular, or flat. One of the outstanding features of Rejafix machines is the very fast exchange of printing type or plates, which permits the use of frequent changes in code numbers and specifications.

Medium-Mu Triode



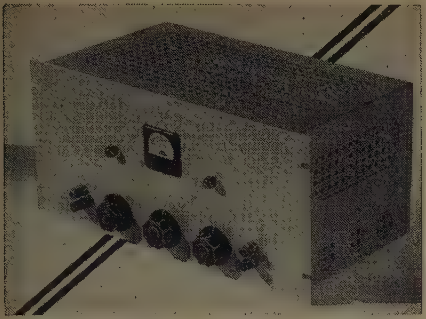
Tube Dept., Radio Corp., of America, Harrison, N. J., has a new type 5718, a medium-mu subminiature triode designed for use as an RF power amplifier and oscillator in uhf applications where dependable performance under shock and vibration is a prime consideration. It is capable of giving a useful power output of nearly 1 watt at 500 mc. Operation with full input is permissible up to 1,000 mc.

Because of its high transconductance, the 5718 is suitable for use in cathode-follower, multivibrator, and blocking-oscillator circuits. It is also useful as a resistance-coupled amplifier.

(Continued on page 274A)

At the I.R.E. Show

Discover How to Get



ABSOLUTE D.C.

See Kay-Lab's amazing new SUPER-REGULATOR produce ABSOLUTE D.C. (Output impedance 0.005 ohms. Noise ripple under 100 microvolts. Standard cell stability available.)

You'll see this and other interesting exhibits in Kay Lab's booth at the I.R.E. Show. Make your visit there a "must."

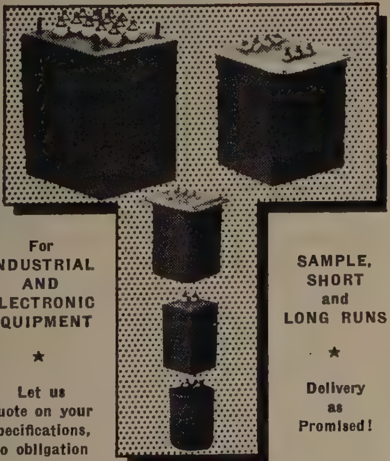
Kay-Lab | PRECISION ELECTRONIC INSTRUMENTS

KALBFELL LABORATORIES, INC.
1090 MORENA BLVD., P.O. BOX 1578
SAN DIEGO 10, CALIFORNIA

EPCO

TRANSFORMERS

" *Fill Your Need to a* "



For INDUSTRIAL AND ELECTRONIC EQUIPMENT

★

Let us quote on your specifications, no obligation

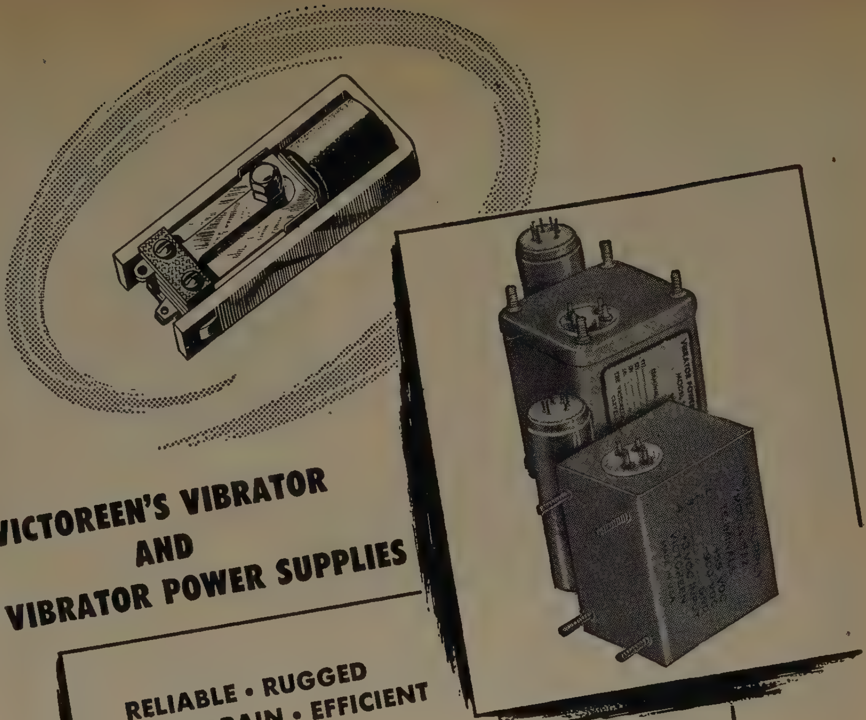
SAMPLE, SHORT and LONG RUNS

★

Delivery as Promised!

DESIGNED TO COMMERCIAL AND MILITARY SPECIFICATIONS (MIL-T-27 and AN-E-19)

EPCO Products Inc.
2500 Atlantic Ave.
Brooklyn 7, New York



VICTOREEN'S VIBRATOR AND VIBRATOR POWER SUPPLIES

RELIABLE • RUGGED
LOW-DRAIN • EFFICIENT

Rapid delivery of Victoreen's subminiature vibrators and vibrator power supplies is now possible due to expansion of our production facilities.

At your service . . . Victoreen's capable engineering staff; designing, engineering, and adapting efficient units to your particular applications.

VIBRATORS

The precision vibrators, used in these power supplies, are available as separate units. They are mounted in sponge rubber and hermetically sealed in a convenient plug-in unit. Proven applications include: high voltage power supplies, scintillation counters, portable Geiger counters, and portable radios. Net weight is 2½ ounces.

THE MODEL 531 VIBRATOR is designed to operate from a 1.5 or 1.3 volt battery and requires as little as 18 milliwatts driving power.

THE MODEL 542 VIBRATOR is also an 18 milliwatt unit, but designed for operation in series with the primary of a transformer and from a 4.5 to 6-volt battery.

VIBRATOR POWER SUPPLIES

Victoreen offers two standard vibrator power supplies for use with battery-operated portable equipment such as Geiger counters, photo-multipliers, and electronic equipment requiring a high voltage supply. These compact units are potted and hermetically sealed for reliability and ruggedness. They contain regulator circuits to insure stabilized outputs. Net weight is one pound.

THE MODEL 517 VIBRATOR POWER SUPPLY operates from 4.5 volts dc and supplies +900 volts at 5 microamperes and +58 volts at 0.25 milliamperes.

THE MODEL 532 VIBRATOR POWER SUPPLY operates from 3.0 volts dc and supplies −900 volts at 15 microamperes and +58 volts at 0.25 milliamperes.

BETTER COMPONENTS MAKE BETTER INSTRUMENTS

The Victoreen Instrument Co.
5806 HOUGH AVENUE, CLEVELAND 3, OHIO

✓ Leading ENGINEERS and TECHNICIANS Recommend . . .

TECH-MASTER
CUSTOM-BUILT TV CHASSIS

GOLD MEDAL SERIES
Deluxe TV Chassis

World's Most Sensitive, Most Reliable TV Receiver—Truly custom-designed and custom-built to provide the ultimate in sight, sound, and value. Employs most advanced engineering methods, finest components, and most rigid alignment and test standards. Tech-Master improved 630-type chassis • Advanced Cascode Standard turret tuner, adaptable to UHF without tools • Full 4 Mc. bandwidth • Quick action keyed AGC circuit • New, Hi-sweep auto-transformer system • 5 microvolt sensitivity • For all picture tubes from 16″ to 24″.

MODEL 2430: with quality PM speaker, all tubes less picture tube, universal picture tube m't'g. brackets, phono-input jack. Equipped with audio take-off to feed sound thru external amplifier, if desired $189.50

MODEL 2431P: Same as 2430, (less sound take-off), but with true fidelity Push-Pull Audio Amplifier $199.95

Chassis plated, gleaming nickel finish . . . completely wired, aligned and tested, ready for installation.

BLUE RIBBON
Custom-built TV Chassis

Designed for the utmost in value, with famous Tech-Master design features for high quality image and sound.

Retains the outstanding characteristics of the RCA-630 circuitry, namely the 4-stage, full bandwidth picture IF strip, and the 3-stage FM sound section • Latest innovations in synch and sweep circuits • Advanced Cascode turret tuner adaptable to UHF without tools • 5 microvolt sensitivity • Permanent magnetic focalizer • A.G.C. level control • 29 tubes (including 4 rectifiers). For all picture tubes from 16″ to 24″.

MODEL C-30: With quality PM speaker, and all tubes (less picture tube), completely wired, aligned and tested $149.50

Sold by all leading Radio Parts Distributors.

Write for detailed literature

TECH-MASTER PRODUCTS CO.
443-445 BROADWAY, NEW YORK 13, N. Y.

FOR FASTER PUMPING WITH SMALLER PUMPS

INTERNATIONAL
HIGH VACUUM
COMPOUND PUMPS

New Model 116
16 CFM Free Air Capacity

Six Ways a Better Pump:

1. SIMPLIFIED CONSTRUCTION
2. ROTARY VANE
3. AUTOMATIC LUBRICATION
4. HIGH EFFICIENCY
5. QUICK RECOVERY
6. RUGGEDLY BUILT

Speed production and reduce maintenance with these ready-to-operate, high efficiency vacuum pumps!

International rotary vane pumps are extremely compact and operate unusually quiet. Simplified construction and automatic lubrication assure trouble-free operation, long life and low-cost upkeep. Pump mechanisms are totally oil submerged, preventing atmosphere to vacuum leakage.

CAPACITIES UP TO 30 C.F.M.
WRITE FOR LITERATURE TODAY

International Pump & Machine Works
PUMP DIVISION
11-13 GOVERNOR STREET
NEWARK 2, NEW JERSEY

SPECIALIST MANUFACTURERS OF INDUSTRIAL GLASS-WORKING MACHINERY AND HIGH VACUUM PUMPS FOR ELECTRONICS, NUCLEONICS AND RESEARCH FOR OVER A QUARTER CENTURY

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 272A)

Tester-Reactivator-Sparker

Transvision, Inc., Dept. DG-3, New Rochelle, N. Y., has released to the television industry its new 6-pound CR Tube Tester-Reactivator-Sparker. This portable instrument is a complete testing and repair unit, self-powered, and completely self-contained. A three-fold function of the instrument is as follows: as a tester, it measures cathode emission, locates shorts between elements, and locates high resistance shorts or leakage as high as 3 megohms; it indicates whether the tube has lost or is losing its vacuum; as a reactivator, the unit can save many dim, worn-out tubes. (The reactivation can be done without removing the picture tube from the TV set.)

In most cases the reactivation is complete and permanent, amounting to a virtual rejuvenation, light emission increases, brightness goes up, and detail is enlivened, which is ideal for new tubes which have lost brightness from prolonged shelf life. This instrument is very effective for aging-in such new tubes.

This unit sparks out electrical leakage which very often develops in picture tubes and makes them inoperative.

Unlike devices used for "flashing" the filament, or permanently raising the filament temperature for temporary relief, this instrument gives a full complex reactivation complete with short aging cycle.

The tester is priced at $34.95 net.

Carbon Film Resistors

The Chase Resistor Co., 9 River St., Morristown, N. J., announces the beginning of production of two high-stability carbon film resistors. For maximum stability these are sealed in glass envelopes, evacuated, baked at high temperature under vacuum, and finally sealed in helium of spectroscopic purity. These units are stable to 0.01 per cent under all environmental conditions, and have long time drift of 0.01 per cent per year or less. They can be supplied in networks with ratios and temperature coefficients held to very close tolerances.

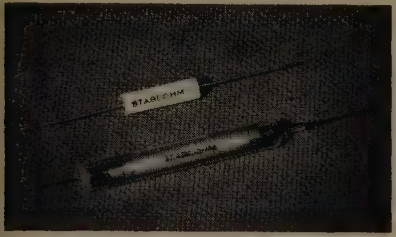
(Continued on page 275A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 274A)

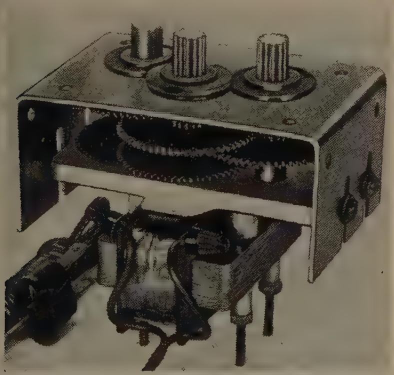
Less expensive units are made by solder-sealing resistors in ceramic tubes with metallized ends. The stability of these is less than that of the glass-helium sealed resistors, but much better than that of varnished resistors, particularly under conditions of high humidity and temperature. Delivery of these in large quantities has begun, with delivery schedules at present of 3 to 4 weeks.



Inquiries for prices on special orders to your specification will be answered promptly. Free literature and sample card for physical dimensions are available upon request on your company stationery.

Geared Motors

General Die & Stamping Company, 262 Mott St., New York 12, N. Y., has developed geared motors that can be supplied with single or multiple shafts, permitting the use of any one, or combination, of a number of speeds from 1 rpm to 1,150 rpm. The shaft diameter is 7/16 inch, while the dimensions are 3¼×4⅝inches×3¼ inches. The motors operate on 110/120 volts ac, 50/60 cps, and have great torque at low and medium speeds.



Standard attachments, such as pistons, bushings, belt pulleys, adaptor plates, and extension shafts are available for the motors, and special attachments and gearing can be supplied if quantity warrants.

The uses of the geared motors include valve controls, electric control drives, sign flashers, remote control devices, current interrupter, industrial mixers, water circulators, etc.

The basic motor also is available, stripped, without gears or bracket, with a shaft speed of 3,000 rpm. Dimensions are 2⅛ inches×3⅛×2. The shaft length is ⅝ inch, and the diameter is 3/16 inch.

A catalog page illustrating and describing the entire series of Kasson motors is available upon request to the company.

See Us at Booth 4-416 IRE Show

ILLUMINATED
CONTROL PANELS - DIALS - KNOBS
AND SWITCHBOARD ASSEMBLIES

Laminated panels, knobs, switches, flat dials and even drum dials have the required letters or figures processed into the background so they appear dead white against the non-reflecting black background. In the dark, small, red-filtered lamps which are inserted in the inside lamination of clear plastic, illuminate the figures with a red light which the eye does not retain when in motion.

All dials and panels are laminated of methyl methacrylate and vinyl films which meet the standards of Specification MIL-P-7788. They will withstand all standard humidity and salt-spray testing; and no change is noted in the overall efficiency of the materials when tested at temperatures varying between —65°C and +85°C.

This new method of making control panels, dials, knobs, etc., lends itself readily to quantity production and competitive costs. For application other than military use, other colors have also been developed.

A booklet with complete information is available.

Manufacturers of test equipment for organic coatings.

UNIVERSAL
UNIVERSAL AVIATION EQUIPMENT, INC.
187 LAFAYETTE STREET, NEW YORK 13, N. Y.
Phone WOrth 4-2670

LOOK WHAT'S NEW!

MADE TO YOUR SPECIFICATIONS
TECHNITROL *Type* TE
PULSE TRANSFORMERS
SEALED IN CASTING RESIN

NOW YOU CAN SIMPLIFY AND MINIATURIZE YOUR SHORT-PULSE CIRCUITS

Currently available in one physical size—3/4" diam. x 9/16" deep, with 2" leads of No. 20 wire—made to your order within the following range of specifications.

Pulse Width: 0.1 to 2.0 microseconds
Maximum Pulse Repetition Rate: 2.0 mc.
Operating Range: —55° to +105°C.

One or two secondaries may be provided, either inverting or non-inverting.

WRITE US YOUR SPECIAL REQUIREMENTS including a brief outline of the contemplated circuit, or ask for our blank specification sheets.

LOOK AT THESE PRICES!

1 to 3	$7.50 each
4 to 10	6.35 each
11 to 100	5.85 each

Write us for quotations for quantities over 100

TECHNITROL
ENGINEERING COMPANY
2751 North 4th Street, Philadelphia 33, Pa.

Visit Our Exhibit Booth 4-107 at the I.R.E. Show

PROFESSIONAL CARDS

ALFRED W. BARBER LABORATORIES

Specializing in the Communications Field and in Laboratory Equipment

Offices, Laboratory and Model Shop at:
32-44 Francis Lewis Blvd., Flushing, L.I., N.Y
Telephone: Independence 3-3306

CROSBY LABORATORIES, INC.

MURRAY G. CROSBY & STAFF
RADIO-ELECTRONIC RESEARCH
DEVELOPMENT & MANUFACTURING
COMMUNICATIONS, FM & TV
ROBBINS LANE
HICKSVILLE, NEW YORK
HICKSVILLE 3-3191

ELDICO OF NEW YORK, INC.

Donald J. S. Merten and Engineering Staff
Consultants on Interference Elimination from Transmitters, Induction Heaters, Diathermy, etc.

44-31 Douglaston Parkway, Douglaston, L.I., N.Y.
Bayside 9-8686

Richard B. Schulz

Electro-Search

Radio-Interfeernce Reduction;
Development of
Interference-Free Equipment,
Filters, Shielded Rooms
4337 N. 5th Street, Philadelphia 40, Pa.
GLadstone 5-5353

ELK ELECTRONIC LABORATORIES, INC.

Jack Rosenbaum

Specializing in design and development of Test Equipment for the communications radar and allied fields

333 West 52nd St., New York 19, PL-7-0520

F-R MACHINE WORKS

INC.

ELECTRONICS FXR X-RAY DIVISION

DESIGN - DEVELOPMENT - MANUFACTURE

44-14 Astoria Boulevard Long Island City 3, N.Y.
Phone AStoria 8-2800

HARRIS GALLAY

Electronic Consultant

Military Electronics Since 1935

Your inquiries solicited and our experience is at your command.

60 Perry Street Belleville 9, N.J.
Plymouth 9-4237

PAUL GODLEY CO.

Consulting Radio Engineers

P.O. Box J. Upper Montclair, N.J.
Offs & Lab.: Great Notch, N.J.
Phone: Montclair 3-3000
Established 1926

HERMAN LEWIS GORDON

Registered Patent Attorney

Patent Investigations and Opinions

Warner Building
Washington 4, D.C.
National 2497

100 Normandy Drive
Silver Spring, Md.
Shepherd 2433

HIGHLAND ENGINEERING CO.

William R. Spittal & Staff

Design, Development and Manufacture of Transformers, Chokes, Etc. for the Electronic, Industrial and Allied Fields

Main & Urban, Westbury, L.I., N.Y.
WE-7-2933

HOGAN LABORATORIES, INC.

John V. L. Hogan, Pres.
APPLIED RESEARCH, DEVELOPMENT, ENGINEERING

Est. 1929. Electronics, Optics, Mechanisms, Facsimile Communication, Digital Computers, Electro-sensitive recording media, Instrumentation.

155 Perry Street, New York 14 CHelsea 2-7855

LEONARD R. KAHN

Consultant in Communications and Electronics

Single-Sideband and Frequency-Shift Systems
Diversity Reception - Modulation Theory
Applications of Magnetic Tape Recording

Elizabeth Bldg., 22 Pine St., Freeport, L.I., N.Y.
Freeport 9-8800

DAVID C. KALBFELL, Ph.D.

KAY-LAB Electronic Instruments
Laboratory and Manufacturing Facilities
Specializing in Electronic
Instrumental and Industrial Problems
1090 Morena Blvd. Woodcrest 6359
San Diego 10, California

MEASUREMENTS CORP.

RESEARCH & MANUFACTURING ENGINEERS

Harry W. Houck Jerry B. Minter
John M. van Beuren

Specialists in the Design and Development of Electronic Test Instruments
BOONTON, N.J.

MICROWAVE SERVICES, INC.

"Architects of Modern Communications"

CONSULTANTS, ENGINEERS, CONSTRUCTORS

Wire, Carrier, Radio—Inside and Outside Plant Facilities

S. K. Wolf, E. Labin, V. J. Nexon, and Associates
45 Rockefeller Plaza, New York 20 Circle 7-4953

L. J. CASTRIOTA M. WIND
S. W. ROSENTHAL P. G. MARIOTTI

Microwave Consultants

Radio Frequency and Microwave Components

Telephone
BOulevard 3-2096

G.P.O. Box 844
Brooklyn 1, N.Y.

PICKARD AND BURNS, INC.

Consulting Electronic Engineers

Analysis and Evaluation of Radio Systems

Research, Development, Design and Production of Special Electronic Equipment and Antennas.

240 Highland Ave. Needham 94, Mass.

PSC APPLIED RESEARCH LTD.

Development & Production

AIRCRAFT and INDUSTRIAL
INSTRUMENTS • AIDS • SYSTEMS
Navigation - Survey - Processing - Servo
Gyro - Photo - Magnetic - Electronic
Radiation - Optical
J. M. Bridgman, General Manager
1450 O'Connor Drive Toronto, Canada

PAUL ROSENBERG ASSOCIATES

Consulting Physicists

100 STEVENS AVE. • MOUNT VERNON, NEW YORK

CABLE: PHYSICIST MOunt vernon 7-8040

TELECHROME, INC.

Electronic Design Specialists

COLOR TELEVISION EQUIPMENT

Flying Spot Scanners, Color Synthesizers, Keyers, Monitors, Oscilloscopes and Related Apparatus

J. R. Popkin-Clurman, Pres. & Ch. Engr.
88 Merrick Rd. Amityville, L.I., N.Y.

TELREX, INC.

M. D. Ercolino, Pres.
H. F. ANTENNA SPECIALISTS
Communication Arrays
Reception or Transmission
For FM, TV, and Amateur Service.
Asbury Park, N.J.—Phone AP 2-7252

WHEELER LABORATORIES, INC.

Radio and Electronics
Consulting — Research — Development
R-F Circuits — Lines — Antennas
Microwave Components — Test Equipment
Harold A. Wheeler and Engineering Staff
Great Neck, N.Y. Great Neck 2-7806

WIHTOL LABORATORIES

Consulting — Research — Development — Electron Tubes — Vacuum and Gas Tube Manufacturing Techniques — Glass Techniques — Special Purpose Tubes.

W. Wihtol, Director
2333 Grey, Evanston, Illinois
University 4-7896

YOUR PRODUCTS HERMETICALLY SEALED

- Meet Military Specifications
- Insure reliability
- Unexcelled high altitude operation
- Provide permanent protection from dust and corrosive atmospheres
- Forever free from humidity effects

Our engineers will design suitable enclosures for your electronic parts. We assemble and seal your units in dry air or inert gas. All assemblies are evacuated and 100% leak tested by the Veeco Mass Spectrometer. Write for complete information.

GENERAL HERMETIC SEALING CORPORATION

99 E. Hawthorne Ave.
Valley Stream, L. I., N.
Tilden 4-6300

3 Important Engineering Meetings

NEREM

Saturday, April 11

Storrs, Conn.

The New England Radio Engineering Meeting is staged by, and is intended primarily to meet the needs of members of the North Atlantic Region, Institute of Radio Engineers. All engineers, scientists, educators, industrialists, students, and others interested in radio and allied fields, are cordially invited to take part in this one-day program of technical papers and exhibits of manufacturers' products, dealing with the broad field of electronics and radio engineering.

Registration should be made in advance, on or before April 4, 1953.

Technical Papers have been arranged to cover every field of radio, in two sessions, morning and afternoon, starting at 10 A.M. and ending at about 5 P.M. Briefly, the subjects are:

Extraneous Disturbances in Servomechanisms

Good Hearing in Auditoriums

Health Physics Survey at the Cosmotron

Propagation Discoveries, Their Lessons

Compatible Color Television

TD-2 Microwave Radio Relay Systems

North Atlantic Region Meeting.

The Luncheon talk is: "Electronics, A Challenger to Space and Time," by Daniel E. Noble.

49 Exhibitors will display a wide line of the latest electronic products. On a sense, no small part of the exhibit will be the campus of the University of Connecticut, to which this meeting and Show have been moved after six years in Boston.

A detailed program can be obtained by writing Mr. A. Millard, Southern New England Telephone Company, New Haven 6, Conn.

Television

Saturday, April 18

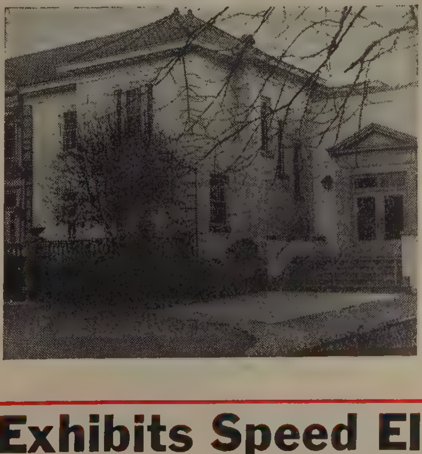
Cincinnati, Ohio

This meeting is jointly sponsored by the Cincinnati Section of the IRE, and the Professional Group on Broadcast and TV Receivers. Annually, a Saturday Meeting, held in the attractive Cincinnati Engineering Club Building, the morning session is comprised of five papers and the afternoon session four papers. All are on Television, and the afternoon papers feature color television exclusively.

Due to the facilities available, the exhibits are limited to television components and test equipment.

Mr. J. W. McRae, President of the IRE will be the principal Banquet Speaker.

Engineering Club Building, Cincinnati, Ohio



May 11, 12, 13

Wednesday, Thursday, Friday

Dayton, Ohio

Airborne Electronics

Now an annual event of national interest, this meeting is jointly sponsored by the Dayton Section of the IRE and the Professional Group on Airborne Electronics.

The exhibits are extensive and occupy several floors of the Hotel Biltmore. The meeting takes three days and includes two luncheons and a Banquet.

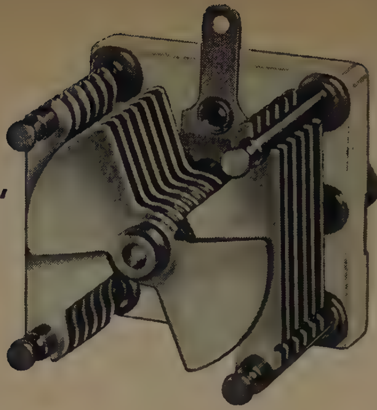
The technical sessions include as subjects: Components, Propagation, Human Engineering, Electronic Instrumentation, Antennas, Vacuum Tube, Microwave, Production Techniques, Servo Analysis, Dielectrics, Circuits, Communications, Analog Computers, Transistors, Network Analysis, Navigation, Measurements, Reliability; in fact every phase of radio-electronics as it applies in aviation.

A detailed program may be obtained from Mr. Peter R. Murphy, 121 Castle Drive, Dayton, Ohio.

IRE Meetings and Exhibits Speed Electronic Progress!

PROCEEDINGS OF THE I.R.E. April, 1953, Vol. 41, No. 4. Published monthly by the Institute of Radio Engineers, Inc., at 1 East 79 Street, New York 21, N.Y. Price per copy: members of the Institute of Radio Engineers $1.00; non-members $2.25. Yearly subscription price: to members $9.00; to non-members in United States, Canada and U.S. Possessions $18.00; to non-members in foreign countries $19.00. Entered as second class matter, October 26, 1927, at the post office at Menasha, Wisconsin, under the act of March 3, 1879. Acceptance for mailing at a special rate of postage is provided for in the act of February 28, 1925, embodied in Paragraph 4, Section 412, P. L. and R., authorized October 26, 1927.

Table of Contents will be found following page 64A



"BFC"

"APC"

When design considerations are critical—Put in HAMMARLUND CAPACITORS

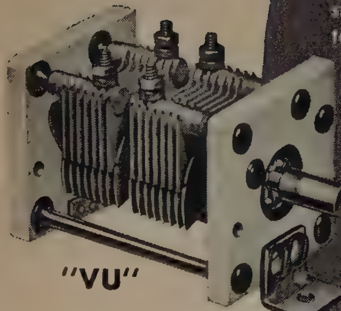
Consider these facts about Hammarlund Capacitors when selecting components for your electronic equipment:

- Plates are of brass, and soldered, not staked, to their supports to insure perfect contact and prevent loosening.
- Precision soldering fixtures and assembly jigs used during fabrication assure uniformity of plate spacing.
- Rotor and stator assemblies are nickel-plated to minimize corrosion.
- Rotor contact springs are beryllium copper or phosphor bronze, and nickel or silver plated, for positive contact.

These are some of the features that make Hammarlund Capacitors your best choice for use in quality electronic equipment.

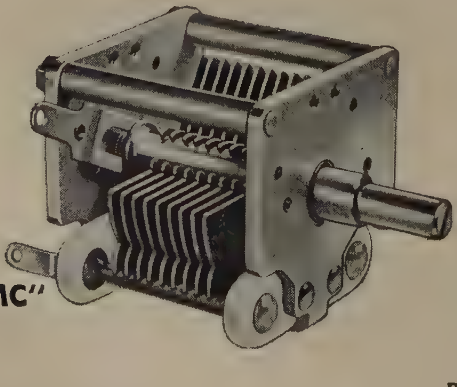
HAMMARLUND

HAMMARLUND MANUFACTURING CO., INC.
460 WEST 34th ST. • NEW YORK 1, N. Y.



"VU"

"MC"



"RMC"

Meetings with Exhibits

● As a service both to Members and the industry, we will endeavor to record in this column each month those meetings of IRE, its sections and professional groups *which include exhibits.*

Δ

April 11, 1953

NEREM—New England Radio Engineering Meeting, University of Connecticut, Storrs, Conn.

Exhibits: H. W. Sundius, The Southern New England Tel. Co., 227 Church St., New Haven, Conn.

Δ

April 18, 1953

Spring Technical Conference of the Cincinnati Section, Cincinnati, Ohio

Exhibits: R. H. Lehman, The Baldwin Co., 1801 Gilbert Ave., Cincinnati 2, Ohio

Δ

May 11, 12 & 13, 1953

National Conference on Airborne Electronics Hotel Biltmore, Dayton, Ohio.

Exhibits: Paul Clark, 120 West Second St., Dayton 2, Ohio.

Δ

August 19, 20, 21, 1953

1953 Western Electronics Show and Convention, Civic Auditorium, San Francisco, Calif.

Exhibits: Heckert Parker, 1355 Market St., San Francisco 3, Calif.

Δ

September 21, 22, 23, 24 & 25, 1953

Eighth National Instrument Conference and Exhibit. Hotel Sherman, Chicago, Ill.

Exhibits: Richard Rimbach, 921 Ridge Ave., Pittsburgh 12, Pa.

Δ

September 28, 29 & 30, 1953

National Electronic Conference Hotel Sherman, Chicago.

Exhibits: Orville Thompson, c/o DeForrest's Training Inc., 2735 N. Ashland Ave., Chicago 14, Ill.

GERMANIUM DIODE INTERCHANGEABILITY CHART

TYPE & MFR.	G.E. REPLACEMENT	MINIMUM FORWARD CUR. @ +1V. (MA)	PEAK INVERSE VOLTAGE (VOLTS)	CONT. REVERSE VOLTAGE (VOLTS)	MAXIMUM REVERSE CUR. (μa) @ −50V.	MAXIMUM REVERSE CUR. (μa) OTHER	REMARKS
1N34 (S,K)		5.0	75	60	800	50 @ −10V.	
	1N48	4.0	85	70	833		
1N34A (S)		5.0	75	60	500	30 @ −10V	
	1N52	4.0	85	70	150		
1N35 (S,K)		7.5	75	50		10 @ −10V.	Matched pairs;
	G8A	4.0	85	70	150		See Note 1
1N38 (S,K)		3.0	120	100		6 @ −3V.	
						625 @ −100V.	
	1N70	3.0	125	100	300	25 @ −10V.	
1N38A (S)		4.0	120	100		5 @ −3V.	
						500 @ −100V.	
	1N63	4.0	125	100	50		
1N39 (S,K)		1.5	225	200		200 @ −100V.	
						800 @ −200V.	
	1N75	2.5	125	100	50		
1N40 (S)		12.75 @ +1.5V.	75	25		40 @ −10V.	Quad; See Note 2
	1N73	15.0 @ +1.7V.	75			50 @ −10V.	Quad; See Note 3
1N41 (S)	None						
1N42 (S)		12.75 @ +1.5V.	120	50		6 @ −3V.	Quad; See Note 2
						625 @ −100V.	
	1N73	15.0 @ +1.7V.	75			50 @ −10V.	Quad; See Note 3
1N43 (WE)		5.0	60		850	20 @ −5V.	
	1N69	5.0	75	60	850	50 @ −10V.	
1N44 (WE)		3.0	115		1000		
	1N70	3.0	125	100	300	25 @ −10V.	
1N45 (WE)		3.0	75		410		
	1N65	2.5	85	70	250		
1N46 (WE)		3.0	60		1500		
	1N48	4.0	85	70	833		
1N47 (WE)		3.0	115		410	4 @ −3V.	
	1N70	3.0	125	100	300	25 @ −10V.	
1N48 (GE)		4.0	85	70	833		
1N51 (GE)		2.5	50	40	1667		
1N52 (GE)		4.0	85	70	150		
1N54 (S,K)		5.0	75	35		10 @ −10V.	
	1N69	5.0	75	60	850	50 @ −10V.	
1N54A (S)		5.0	75	50	100	7 @ −10V.	
	1N52	4.0	85	70	150		
1N55 (S,K)		3.0	170	150		300 @ −100V.	
						800 @ −150V.	
	1N75	2.5	125	100	50		
1N55A (S)		4.0	170	150		500 @ −150V.	
	1N63	4.0	125	100	50		
1N56 (S,K)		15.0	50	40		300 @ −30V.	
	1N69	5.0	75	60	850	50 @ −10V.	
1N56A (S)		15.0	50	40		300 @ −30V.	
	1N69	5.0	75	60	850	50 @ −10V.	
1N57 (S,K)		4.0	90	80		500 @ −75V.	
	1N52	4.0	85	70	150		
1N58 (S,K)		4.0	120	100		800 @ −100V.	
	1N63	4.0	125	100	50		
1N58A (S)		4.0	120	100		600 @ −100V.	
	1N63	4.0	125	100	50		
1N60 (S,K)			30	25			See Note 4
	1N64	.05 @ +0.25V.	20			25 @ −1.3V.	See Note 5
1N61 (K)		5.0	140	130		300 @ −100V.	
						700 @ −125V.	
	1N63	4.0	125	100	50		
1N63 (GE)		4.0	125	100	50		
1N64 (GE)		.05 @ +0.25V.	20			25 @ −1.3V.	See Note 5
1N65 (GE)		2.5	85	70	250		
1N66 (R)		5.0	70	60	800	50 @ −10V.	
	1N48	4.0	85	70	833		
1N67 (R)		4.0	100	80	50	5 @ −5V.	
	1N63	4.0	125	100	50		
1N68 (R)		3.0	120	100		625 @ −100V.	
	1N75	2.5	125	100	50		
1N69 (GE)		5.0	75	60	850	50 @ −10V.	
1N70 (GE)		3.0	125	100	300	25 @ −10V.	
1N71 (S)	None						Quad
1N72 (GE)		0.8 @ +.5V.	5			800 @ −.5V.	See Note 6
1N73 (GE)		15.0 @ +1.7V.	75			50 @ −10V.	Quad; See Note 3
1N74 (GE)		15.0 @ +1.8V.	75			50 @ −10V.	Quad; See Note 3
1N75 (GE)		2.5	125	100	50		
CK705 (R)							Same as 1N66
CK706 (R)			50	40		200 @ −10V.	See Note 7
	1N64	.05 @ +0.25V.	20			25 @ −1.3V.	See Note 5
CK707 (R)		3.5	100	80	100	8 @ −5V.	
	1N52	4.0	85	70	150		
CK708 (R)							Same as 1N68
CK709 (R)				60			Quad; See Note 8
	1N73	15.0 @ +1.7V.	75			50 @ −10V.	Quad; See Note 3
CK710 (R)		3 @ +0.5V.	10	5		200 @ −.6V.	See Note 9
	G7A						See Note 6
CK711 (R)				80	30		Quad; See Note 10
	1N73	15 @ +1.7V.	75			50 @ −10V.	Quad; See Note 3
CK712 (R)		2.0	225	200		800 @ −200V.	
	1N75	2.5	125	100	50		
CK713 (R)		21 @ +2.0V.	75	75		250 @ −40V.	
	1N52	4.0	85	70	150		
1N81 (GE)		3.0	50	40		10 @ −10V.	
1N82							UHF Mixer
	G7A	0.8 @ +.5V.				800 @ −.5	See Note 6
CK715 (R)							Frequency Mult.
	G7E	0.8 @ +.5V.	5			800 @ −.5	Frequency Mult.
1N91 (GE)		1000	100				Diffused Junction Rectifiers
1N92 (GE)		1000	200				
1N93 (GE)		1000	300				
1N94 (GE)		1000	400				
G11 (GE)							Transistor
G11A (GE)							Transistor

NOTE 1: Forward resistances matched within 10% at +1V.

NOTE 2: Four diodes in tube shell with forward resistances balanced within +2.5% at +1.5V. Forward resistances of each pair matched within 3 ohms.

NOTE 3: Four diodes in hermetically sealed tube shell. Forward resistances matched within 6.7 ohms for 1N73 and 13.4 ohms for 1N74 at 15 Ma. Forward resistances of each pair matched within 2 ohms for 1N73 and 6.7 ohms for 1N74 at 15 Ma.

NOTE 4: Tested with 1.8V. RMS input at 40 Mc, 70% modulated at 400 cycles. Minimum output is 1.8V. peak-to-peak across 4700 ohms shunted by 5 MMF.

NOTE 5: Tested with 0.1V. RMS, 44 Mc input to last I.F. grid. Minimum output is 100 μa through 3600 ohms shunted by 5 MMFD.

NOTE 6: Maximum conversion loss is 10db measured at 900 Mc with 0.7 Mw L.O. level and d-c forward bias from a 0.25V., 250 ohm source.

NOTE 7: Tested with 0.1V. RMS, 50 Mc input to last I.F. grid. Minimum output is 330 μa through 5100 ohms shunted by 5 MMFD.

NOTE 8: Four diodes in tube shell with forward resistances matched within 2.5%. At −10V. diodes are matched 2.5% or all have a resistance greater than 1.0 meg ohm.

NOTE 9: Typical noise temperature ratio of 2.

NOTE 10: Four diodes in tube shell. Each pair of diodes is shunted by 10,000 ohms center-tapped and the center tap of resistor and diodes connected by a microanimeter. With 0 to +3V. dc applied unbalance current limit is 5 MA.

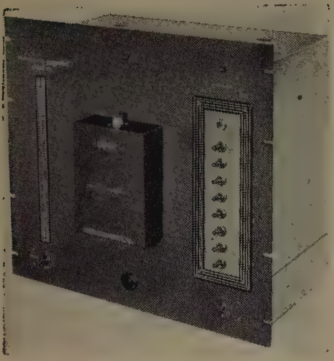
- *For a free file card copy of this data write: General Electric Co., Section 5243, Electronics Park, Syracuse, N.Y.*

GENERAL ELECTRIC

NEWS and NEW PRODUCTS

April 1953

Millimicrosecond Pulse Generator



Electrical and Physical Instrument Corp., 42-19 27th St., Long Island City, announces the Model 100 millimicrosecond pulse generator, which utilizes a new method of pulse shaping. Square pulses of rise time of 1 millimicrosecond, (0.001 μsec.) with a comparable decay time and of width which can be varied from 2 millimicroseconds to several microseconds are generated. The maximum pulse amplitude is 100 volts into low impedance cables (such as 50 ohms) for a pulsed power output of 200 watts; outputs up to 800 watts are also available. The output amplitude can be attenuated a total of 84 db in one db steps to cover the range of 100 volts to 0.006 volt. A polarity switch on the front panel allows the selection of either positive or negative pulses. Two or more pulse outputs, each of which can be individually attenuated and delayed are available in some models. The repetition rate is 60 pps with control for a single pulse operation available. Pulse widths are: 2.0 millimicroseconds 2.0×10^{-9}, 5.0 millimicroseconds 5.0×10^{-9}, 7.5 millimicroseconds 7.5×10^{-9}, 10 millimicroseconds 10^{-8}, 25 millimicroseconds 2.5×10^{-8}, 50 millimicroseconds 5×10^{-8}, $\frac{1}{10}$ microsecond 10^{-7}. Other values of pulse widths are available upon request, and instructions for obtaining any pulse width desired from 2 millimicroseconds to several microseconds are included with the unit.

Transformer Catalog

Peerless Electrical Product Div., Altec Lansing Corp., has just released its new 15-page transformer catalog and price list containing 92 items. This catalog lists many new items including the new line of 20-20 plus transformers, and also describes facilities for the design and manufacture of Class A, B, and H transformers, which are built to meet JAN-T27 and MIL-T 27 specifications. Catalogs and price lists may be obtained by writing to Peerless Electrical Products Div., Altec Lansing Corp., 9356 Santa Monica Blvd., Beverly Hills, Calif., or 161 6th Ave., New York 13, N. Y.

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

The **Panel on Electron Tubes of the Research and Development Board** is sponsoring a symposium on Ceramic-To-Metal Seals at the **Rutgers University** School of Ceramics on **April** 21, 1953.

For further information contact Harry J. Sullivan at 346 Broadway, New York, N.Y., REctor 2-8000.

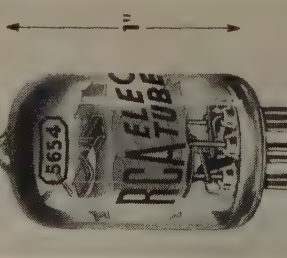
Time Calibrator

The Type 190 Low-Frequency Time Calibrator, a synchronous-motor driven device furnishing pulses at intervals of 0.01, 0.1, or 1.0 second, is now available from Owen Laboratories, Pasadena, Calif.

It is intended for use with oscilloscopes and various types of recording equipment in electrical, mechanical, and biological investigations. Pulse amplitude is about 1.5 volts. Size is $5\frac{1}{4}\times3\frac{1}{4}\times3$ inches, and the price is $48 postpaid.

Sharp-Cutoff Pentode

Tube Dept., Radio Corp. of America, Harrison, N. J., has a new type 5654, a "premium" version of the miniature sharp-cutoff pentode 6AK5 for use as a broad-band RF or IF amplifier in mobile and aircraft receivers. It is constructed and processed to meet military requirements.



Featured in the 5654 is a compact structure especially designed to provide increased mount strength against shock and vibration, and a pure-tungsten heater to give long life under conditions of on-off switching.

Elapsed Time Indicator

R. W. Cramer Co., Centerbrook 5, Conn., has a new type ET time totalizer, used to measure and indicate elapsed time intervals wherever very precise measurement of time is required.

Two models are available: One has scale divisions of 0.01 second and a total range of 50 seconds, and the other has divisions of 0.01 minute and a total range of 50 minutes. Accuracy for either is better than 0.02 of of 1 per cent.

Prime feature of the new time totalizer is a unique differential clutch mechanism that insures high accuracy and positive clutching throughout the life of the device. Instead of the conventional friction or face plate clutch, the motor is here permanently connected to the sun gear of a differential gear system. One of the differential members is connected to the pointer system, while the other goes to a free gear.

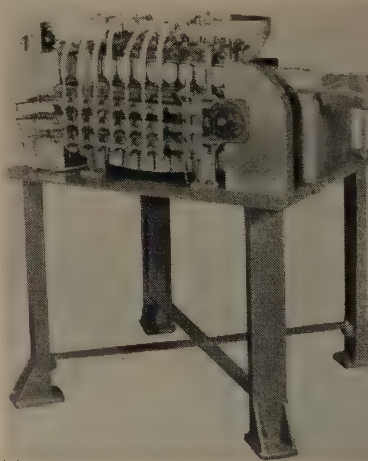
Forms of this time totalizer are available to meet the most exacting military specifications with regard to shock, vibration, temperature, etc.

For complete details write for Bulletin 690.

Tube Bottoming Machine

Kahle Engineering Co., 1307 Seventh St., North Bergen, N. J., has announced the production of a completely automatic tube bottoming machine.

This special-purpose machine, Model 2048, was designed and built to produce miniature lamp bulbs for switchboard and telephone use.



The machine, producing 4,000 units per hour, eliminates older methods of lifting the glass from one position to the next by using a continuous conveyor principle. Cut tubing of required length is dumped into a rubber-lined hopper; the glass is then indexed straight through the machine and is not "jumped" or "bumped" in the process. In machine breakage and rejects are consequently held to a minimum. In addition, Model 2048 can be used to produce round or flat bottomed test tubes, vials, and containers.

(Continued on page 44A)

Whenever circuits call for precision and high resolution in compact space . . .

There's a 10-turn Helipot to meet *your* requirements

With the development of the original HELIPOT—the *first* multi-turn potentiometer—an entirely new principle of potentiometer design was introduced to the electronic industry. It made possible variable resistors combining high resolution and high precision in panel space no greater than that required for conventional single-turn potentiometers.

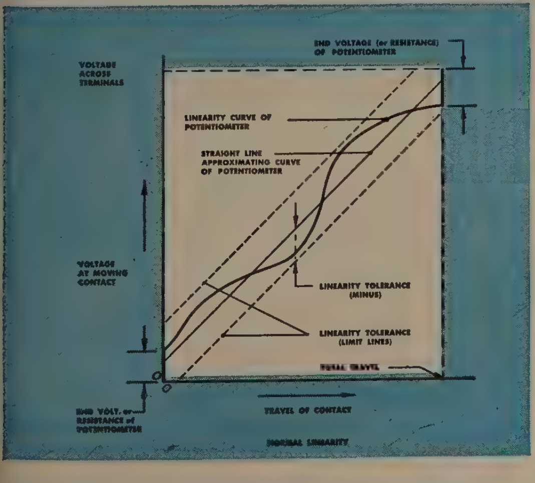
The Helipot Principle . . . *High resolution and precision settings require a long slide wire. But by coiling a resistance element into a helix, it is possible to gain desired resolution and precision without wasting panel space. This principle is applied in various Helipot models with slide wires ranging from 3 to 40 helical turns.*

Advantages are immediately apparent. In the case of the widely-used 10-turn Model A Helipot, for example, a 45″ long slide wire—coiled into ten helical turns—is fitted into a case 1¾″ in diameter, and 2″ in length. Another advantage of the 10-turn pot is that, when equipped with a turns-indicating RA Precision DUODIAL, slider position can be read directly as a decimal, or percentage, of total coil length traversed.

10-TURN HELIPOT MODELS—CONDENSED SPECIFICATIONS

	Model A	Model AN	Model AJ
No. of turns	10	10	10
Resistance Range	10 ohms to 300,000 ohms	100 ohms to 250,000 ohms	100 ohms to 50,000 ohms
Resistance Tolerance:			
Standard	±5%	±5%	±5%
Best	±1%	±1%	±3%
*Linearity Tolerance:			
Standard	±0.5%	±0.5%	±0.5%
Best	±0.05% (1K ohms and above)	±0.025% (5K ohms and above)	±0.1% (above 5K ohms)
Power rating @ 40°C	5 watts	5 watts	2 watts
Mechanical Rotation	3600° +4° −0°	3600° +1° −0°	3600° +12° −0°
Electrical Rotation	3600° +4° −0°	3600° +1° −0°	3600° +12° −0°
Starting Torque	2 oz. in.	1.0±.3 oz. in.	.75 oz. in.
Running Torque	1.5 oz. in.	0.6±.3 oz. in.	.60 oz. in.
Net Weight	4 oz.	4 oz.	1 oz.

*i.e. INDEPENDENT LINEARITY. The above linearity tolerances are based on the following definition recently proposed to clarify and standardize nomenclature related to precision variable resistors. . . . "Independent linearity is the maximum deviation in per-cent of the total electrical output of the actual electrical output at any point from the best straight line drawn through the output versus rotation curve. (This line shall be measured through the extent of the effective electrical angle.) The slope and position of the straight line from which the linearity deviations are measured must be so adjusted as to minimize these deviations."



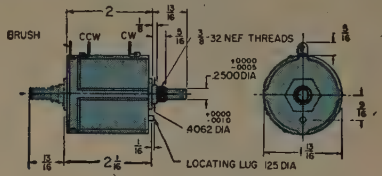
10-Turn Helipot Highlights

From the basic Helipot principle, model variations have been developed to meet new requirements:

Model A Helipot

the original 10-turn Helipot—provides a resolution from 12 to 14 times that of conventional single-turn potentiometers of same diameter (1¾″), linearities as close as ±0.05% in resistances as low as 1K ohms.

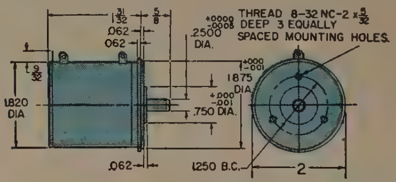
The same multi-turn principle is also available in 3 turn units (Model C), and larger-diameter units of 15 turns (Model B), 25 turns (Model D), and 40 turns (Model E)—a type for every application from 5 ohms to 1 megohm.

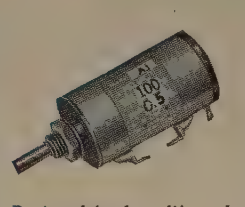


Model AN Helipot

an ultra-precision version of the basic 10-turn Helipot. Produced in volume to extremely close electrical and mechanical tolerances, this unit features precision ball bearings (Class 5), servo mounting lid, plus linearity tolerance as close as ±0.025% as low as 5K. A 3-turn unit (Model CN) is also available.

Models AN and CN are particularly recommended for precise servo-mechanism applications and represent the most advanced design and highest quality available today in the field of precision potentiometers.

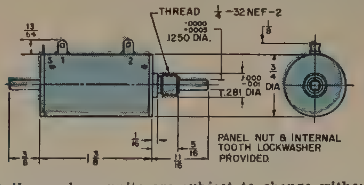




Model AJ Helipot

a 10-turn *miniature* Helipot only ¾″ in diameter, weighs 1 oz., has slide wire 18″ long. Also available with servo mounting (Model AJS) and servo mounting with *ball* bearings (Model AJSP). Linearities as close as ±0.1% as low as 5K.

Designed for long life under severe operating conditions, the AJ Series is widely used where small size and weight are vital.



Design details on above units are subject to change without notice. Certified drawings available upon request.

Only Helipot is able to supply—in volume—multi-turn helical potentiometers *with special features to meet your particular needs* . . . Special Shafts, Extra Spot Welded Taps at any position, Ganged Assemblies (except AJ), Special Temperature Coefficients, etc. Send us your requirements!

For complete details contact your nearby Helipot representative. Or write direct.

THE Helipot CORPORATION

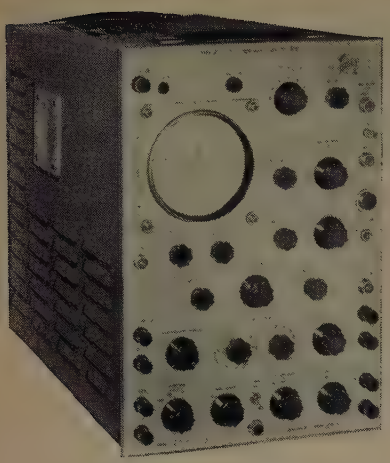
A subsidiary of Beckman Instruments, Inc.

SOUTH PASADENA 6, CALIFORNIA

Field Offices: Boston, New York, Philadelphia, Rochester, Schenectady, Cleveland, Detroit, Chicago, St. Louis, Los Angeles, Seattle, Dallas, High Point, N. C. and Fort Myers, Florida. In Canada: J. S. Root, Toronto. Export Agents: Frathom Co., New York 36, New York.

TRANSIENT ANALYSIS

Type 513-D—High Writing Rate Oscilloscope



TWELVE KV accelerating potential provides the light intensity necessary for photographic recording of single high-speed sweeps, or visual observation of pulses of low duty cycle. Increased brightness and removal of residual charge from previous sweeps result from use of metallized CRT screen.

TRIGGERED SWEEPS. Signals producing 0.5 cm or greater deflection will trigger the sweep. Trigger pulses may be as short as 0.05μsec. Sweep easily made recurrent when desired.

WIDE BAND. Factory adjusted for optimum transient response, the Type 513-D distributed vertical amplifier has a risetime of 0.025 μsec with no appreciable ringing or overshoot.

VERTICAL AMPLIFIER
Sensitivity
0.3 v/cm to 100 v/cm dc
0.03 v/cm to 100 v/cm ac
Transient response
0.025 μsec risetime
Signal delay
0.25 μsec

CALIBRATING VOLTAGE
Square wave, approximately 1 kc
Seven ranges, 0.05 v to 50 v
Accurate within 3% of full scale

TIME BASE
0.1 μsec/cm to 0.01 sec/cm
Continuously variable
Accurate within 5% of full scale

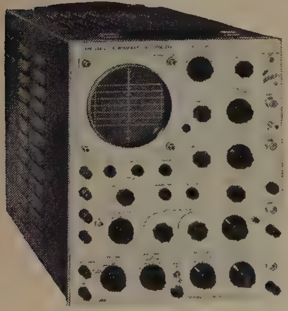
REGULATION
All dc voltages electronically regulated

WAVEFORMS AVAILABLE
Calibrating voltage
Gate
Delayed gate
Delayed trigger
Sweep sawtooth
Trigger rate generator
(200 to 5000 cps)

SELF-CONTAINED
Weight 79 lbs.

TEKTRONIX Type 513-D Cathode-Ray Oscilloscope, $1650 f.o.b. Portland, Oregon

TEKTRONIX, Inc.
P. O. Box 831B, Portland 7, Oregon • Cable: TEKTRONIX

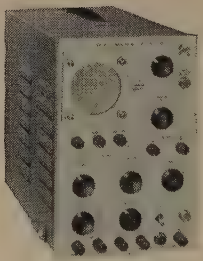


Type
524-D

Television Scope

Designed especially for TV Broadcasters, the Type 524-D permits observation of a field one line at a time with push-button shift to corresponding line in opposite field. New magnifier, 3x or 10x, expands sweep to right and left of center. Time markers for accurate sync pulse timing.

TIME BASES—0.1 μsec/cm to 0.01 sec/cm continuously variable, accurate within 5%.
VERTICAL SENSITIVITY
dc to 10 mc—0.15 v/cm to 50 v/cm
2 cps to 10 mc—0.015 v/cm to 50 v/cm
TRANSIENT RESPONSE — 0.04 μsec risetime
SIGNAL DELAY — 0.25 μsec
5″ CRT — flat-faced, 4 kv accel. potential
Type 524-D — $1180



Type
315-D

Wide Time Base Range

Read time and amplitude directly from the screen. 24 accurately calibrated time bases...12 accurately calibrated vertical sensitivity positions.

TIME BASES — 0.1 μsec/div to 5 sec/div
VERTICAL SENSITIVITY
dc to 5 mc — 0.1 v/div to 50 v/div
5 cps to 5 mc 0.01 v/div to 50 v/div
TRANSIENT RESPONSE — 0.07 μsec risetime
3″ CRT — high definition, flat-faced
Type 315-D — for use on 50-60 cycle line..........**$770**
Type 315-D — for use on 50-800 cycle line.........**$785**

Prices f.o.b. Portland, Oregon
These three and other oscilloscopes fully described in the 1953 Tektronix Catalog. Write to the above address.

Industrial Engineering Notes[1]

TELEVISION NEWS

The Italian government is buying a considerable amount of television equipment from a British firm for use in its studios at Rome and Milan, according to reports reaching the Department of Commerce. Medium-power transmitting equipment also is being purchased for use at Rome and Pisa. The equipment is expected to be used to expand the services of the present experimental station of the official Italian broadcasting corporation, Radio Audizione Italiana (R.A.I.), into a full-scale network. When completed, most of Italy would receive television service from transmitters located in nine main population areas. A two-way radio link is proposed between Rome and Milan, with programs originating in these two cities. . . . Speaking before the National School Boards Association Convention last week in New Jersey, **Paul A. Walker, Chairman of the FCC, said that now was the time for educators, school board members, trustees, legislators and governors to take definite and timely action to support plans in the respective communities for the utilization of the 242 channels for non-commercial educational television stations.** Chairman Walker pointed out that the end of the one-year reservation period for educational TV channels is June 2, 1953, and that these channels set aside by the FCC for educational TV cannot be held indefinitely beyond this deadline. . . . **A total of 6,174,505 television sets were shipped to dealers during 1952, RMTA has estimated.** This compares with 1951 TV set shipments to dealers of 5,095,563 units. . . . **The FCC granted construction permits for new television stations recently to bring the total authorizations since the lifting of the "freeze" last summer to 254.** Authorized since January 28 have been:

Fort Dodge, Northwest Television Co., Channel 21.

Madison, Wis., Bartell Television Corp., Channel 33.

Roswell, N. Mex., John A. Barnett, Channel 8.

Salem, Ore., Lawrence A. Harvey, Channel 24.

Johnson City, Tenn., WJHL, Inc., Channel 11.

Memphis, Tenn., Harding College, Channel 13.

Temple, Texas, Bell Publishing Co., Channel 6.

Tyler, Texas, Jacob A. Newborn, Jr., Channel 19.

Charlottesville, Va., Barham & Barham, Channel 64.

Lansing, Mich., Lansing Broadcasting Co., Channel 54.

Billings, Mont., The Montana Network, Channel 2.

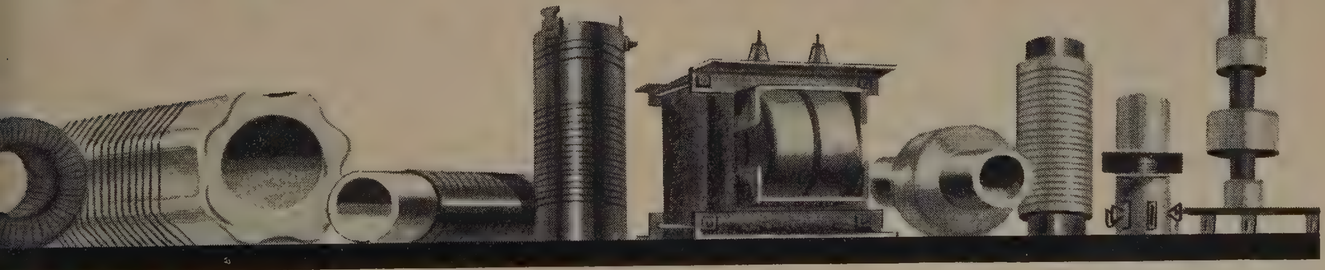
(Continued on page 72A)

---

[1] The data on which these NOTES are based were selected by permission from *Industry Reports*, issues of February 6, 13, 20, and February 27, published by the Radio-Television Manufacturers Association, whose co-operation is gratefully acknowledged.

max*

A-27 RF LACQUER



* REGISTERED TRADE NAME

s chemically engineered to meet the
pecific requirements of the industry

ARLBORO, NEW JERSEY — Telephone: FReehold 8-1880

Multi Scope!

WHEN A SINGLE SCOPE WON'T DO YOUR JOB!

Try to compare four different but related phenomena . . . at the same instant . . . under the same conditions . . . with single channel oscilloscopes . . . and you run into trouble. Nine times out of ten, you'll miss those high speed signals.

There are several ETC oscilloscopes that lick the problem by displaying *four* phenomena on the face of a single 5" tube. Since their development they have opened new fields in electronic and medical research, strain and vibration analysis, seismography and ballistics.

Each of their four channels has independent controls for intensity, focus, and positioning of the X and Y axes. All input signals can be observed on a common time base or on separate time bases if desired. Wide band, high gain, DC or AC amplifiers are provided on both the vertical and horizontal axes.

Details about the four-channel models available as well as others with 2, 5, 6, 8, or even 10 channels are covered in our catalog. Write for your copy today.

ETC

electronic tube corporation

1200 E. MERMAID LANE, PHILADELPHIA 18, PA.

Industrial Engineering Notes

(Continued from page 66A)

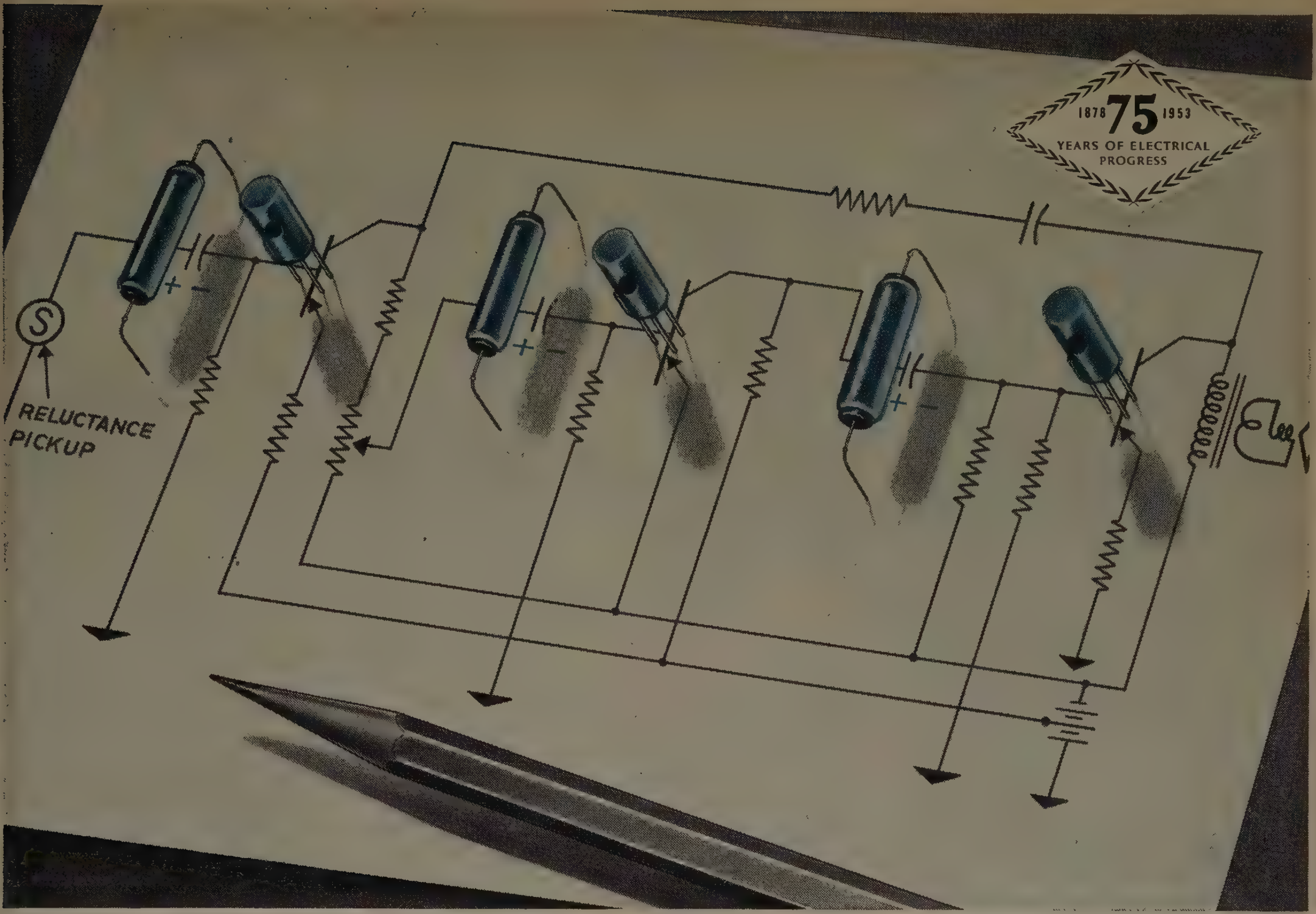
Winston-Salem, N. C., Winston-Salem Broadcasting Co., Inc., Channel 26.
Ashtabula, Ohio, WICA, Inc., Channel 15.
Texarkana, Texas, KCMC, Inc., Channel 6.
Longview, Texas, East Texas Television Co., Channel 32.
Hampton, Va., Peninsula Broadcasting Corp., Channel 15.
Newport News, Va., Eastern Broadcasting Corp., Channel 33.
Milwaukee, Wis., Midwest Broadcasting Co., Channel 25.
Mesa, Ariz., Harkins Broadcasting, Inc., Channel 12.
Eureka, Calif., Redwood Broadcasting Co., Inc., Channel 3.
Rome, Ga., Coosa Valley Radio Co., Channel 9.
Wichita, Kan., The C.W.C. Company, Inc., Channel 16.
New Orleans, La., Supreme Broadcasting Co., Inc., Channel 61.
North Adams, Mass., Greylock Broadcasting Co., Channel 74.
Portland, Me., Portland Telecasting Corp. Channel 53.
Gulfport, Miss., WGCM Television Corp., Channel 56.
Hannibal, Mo., Courier-Post Publishing Co., Channel 7.
Minot, N. D., Rudman Television Co., Channel 10 and North Dakota Broadcasting Co., Inc., Channel 13.
Oklahoma City, Okla., Oklahoma County Television & Broadcasting Co., Channel 25.
McAllen, Texas, Texas State Network, Inc., Channel 20.
Salinas, Calif., Salinas Broadcasting Corp., and Monterey Radio-Television Co., Channel 8.

The grant to Salinas Broadcasting Corp. and Monterey Radio-Television Co. was the first share-time television operation authorized by the FCC. The same Channel 8 transmitter will be used by both stations on an equal-time basis and both stations will maintain their own studios in the two cities.

FCC ACTIONS

The FCC issued a Report and Order this week relaxing its operator license requirements to permit the remote control operation of certain low-power AM, FM, non-commercial FM broadcast stations. "The marked improvement and reliability of transmitter equipment" and "the successful operation by non-technical personnel of many electronic devices of a complex nature," it was pointed out, were among the factors considered by the Commission in reaching its decision. . . . **The FCC recently finalized its proposed rule making of May 10, 1952, to open a section of the amateur frequency band—21,000–21,450 kc—for the use of radio-telephony by amateurs,** beginning last month. This band is allocated to amateurs in accordance with the international table of frequency allocations (Atlantic City, 1947). The radio-telephone

(Continued on page 74A)



TRANSISTORS . . . TANTALYTIC CAPACITORS

teamed in 100-milliwatt tubeless amplifier

General Electric engineers at Electronics Park, Syracuse, have developed a new tubeless audio amplifier circuit that utilizes three junction transistors and three Tantalytic capacitors.

Although still experimental, this 3-stage amplifier promises significant advances in miniaturized equipments. It has a power output of 100 milliwatts—less than 10% distortion—and a power gain of 70 db.

Tantalytic capacitors were a "natural" for interstage coupling in the circuit because of their small size, large capacitance and low leakage current. They match the transistors in ruggedness and long operating life. And they will operate over a wide temperature range (−55°C to +85°C with at least 65% capacitance at −55°C). Other features include light weight, long shelf life, and hermetic sealing.

If you have a capacitor application where you need small size and superior performance, it will pay you to investigate Tantalytic capacitors. They're available in polar and non-polar construction and in ratings from 175 muf at 5 VDC to 12 muf at 150 VDC. For additional information use the convenient coupon below.

General Electric Company, Schenectady 5, New York.

General Electric Co., Section K 407-313
Schenectady 5, New York

Gentlemen: Please send me a copy of your free Bulletin(s)
☐ **GEC-808 and GER-451 "Tantalytic Capacitors"**
☐ **ECG-1 "Germanium Transistors"**

Name______________________________

Company______________________________

Street______________________________

City________________**Zone**____**State**_____

GENERAL ELECTRIC

4 NEW Potter FREQUENCY-TIME COUNTERS...

Automatically READS FREQUENCY, TIME INTERVAL AND PERIOD

NEW
- COMPACT DESIGN
- CIRCUITS
- FEATURES
- LOWER PRICES

USE THEM FOR

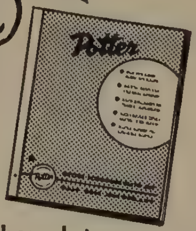
FREQUENCY MEASUREMENTS
•
PERIOD MEASUREMENTS
•
TIME INTERVAL MEASUREMENTS
•
FREQUENCY RATIO MEASUREMENTS
•
SECONDARY FREQUENCY STANDARD
•
TOTALIZING COUNTER
•
DIRECT RPM TACHOMETER

Every known need in frequency and pulse measurement is now satisfied by four completely new designs of Potter frequency-time counting equipment.

The simplified Potter 100 KC Frequency, Models 820 and 830, are suitable for rapid and precise production line applications. The versatile Potter 100 KC and 1 MC Frequency-Time Counters, Models 840 and 850, include all gating, switching, timing and counting circuitry required for any conceivable counting-type measurement.

All models feature the convenience of smaller size, lighter weight, and functional panel layout. And, optional readout indication—either the dependable Potter 1-2-4-8 decimal readout or the conventional 0-9 lamp panels—is available.

Tells All about Frequency-Time Counters—both laboratory and industrial applications.



For further data or engineering assistance write Dept. 4-E.

POTTER INSTRUMENT COMPANY, INC.

115 CUTTER MILL ROAD
GREAT NECK, N. Y.

Industrial Engineering Notes

(Continued from page 72A)

segment of this band is designated from 21.25 to 21.45 mc. The frequency space for Novice operation is provided at 21.10–21.25 mc. The previously proposed segment for amateur F-1 (radio-teleprinter operation) has been shifted to 21.0–21.25 mc. In general, these amendments to the amateur rules (Part 12) are designed to provide maximum usefulness of the new amateur band in the interests of the various types of amateur operation, FCC reported. A request of the Maritime Mobile Amateur Radio Club to permit amateur mobile operation in the 21 amateur band outside the continental limits of the United States will be considered separately, the Commission said. . . . **The FCC at present will not consider applications for FM stations contemplating a "functional service" program schedule.** This was revealed in a letter released by the Commission and sent to Chicago Skyway Broadcasting Co., Inc., Chicago, applicant for an FM station there. It was pointed out that "the Commission is currently reviewing the legality and general desirability of 'Storecasting' and similar 'Functional Music' operations. Until this study is completed, the Commission is of the opinion that additional 'Storecasting' operations should not be authorized pending the resolution of the policy questions presented by such operations."

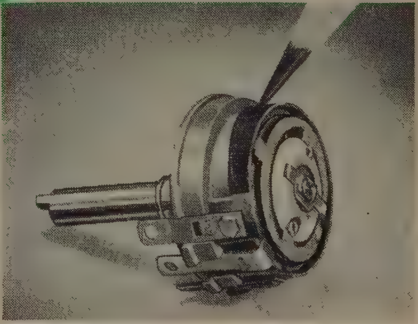
RADIATION MEASURING DEVICE

A report describing methods for producing better atomic radiation measuring devices was issued by the Office of Technical Services, Department of Commerce. In developing the methods, Naval Research Laboratory scientists used rapidly-recurring, brief voltage pulse instead of a continuous high voltage on the electrodes in the Geiger tube. By not applying continuous high voltage, the scientists obtained these desirable characteristics: (1) A greater measuring range by combining continuous and pulsed voltage operation; (2) useful counter operations at higher intensity levels; (3) meter reading increases in direct proportion to the increase in radiation intensity; and (4) a wider choice of filling gas. The report, "Pulsed Geiger Tube Operations" PB 111035, is available at the Office of Technical Services, U. S. Department of Commerce, Washington 25, D. C. for 50 cents per copy.

REORGANIZATION OF RTMA URGED

The RTMA Board of Directors yesterday accepted in principle recommendations of a special committee of the Technical Products Division calling for broad expansion and reorganization of the Radio-Television Manufacturers Association to provide greater recognition for manufacturers in the advanced electronics field. The action climaxed a three-day industry conference in February at the Roosevelt Hotel, New York. The major recommendations of the committee were that: (1)

(Continued on page 76A)



Draw the wire-wound control curve you need: Clarostat winds the "card" to match it. Specify tolerances: Clarostat meets them. Order any quantity: Clarostat delivers piece after piece, always *uniform*, always *dependable*, always *economical*.

All because Clarostat-designed and built winding machines, manned by skilled winding specialists, handle any kind and size of wire on any kind and shape support. Intricate control curves are met with tapered or notched supporting strips, by variable spacing of turns, by different wire sizes. From 0.032" down to 0.0009" dia. and finer, Clarostat winds to your precise requirements.

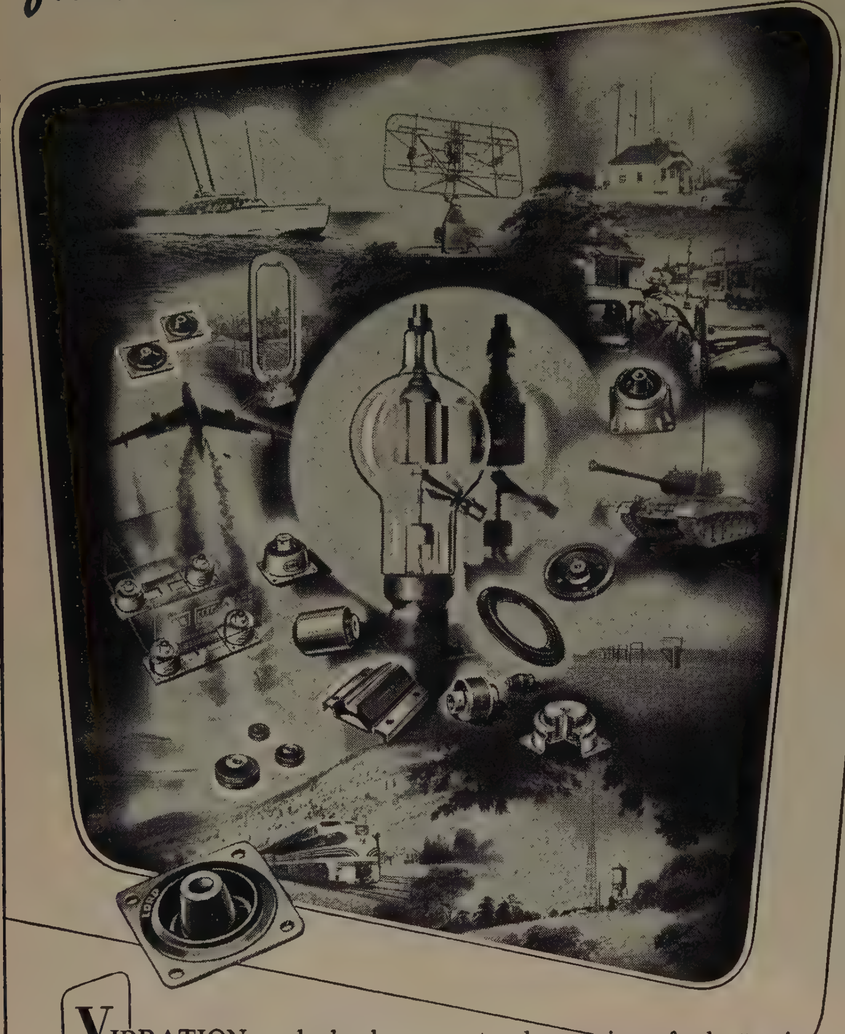
STAND PAT WITH

Send us that control spec, regardless how "special". Our engineering collaboration, quotations and delivery schedules, are yours for the asking.

CLAROSTAT Controls & Resistors

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario

LORD MOUNTINGS PROTECT INSTRUMENTS *and* ELECTRONIC EQUIPMENT *from* VIBRATION *and* SHOCK DAMAGE • • •



VIBRATION and shock are natural enemies of electronic equipment and precision instruments . . . To control the damage which these enemies can do, Lord Vibration Control Mountings and Bonded Rubber Parts are used to very profitable advantage. More than a quarter century's experience in dealing with vibration and shock is yours when you take advantage of Lord engineering assistance. The result of such consultation is full protection for electronic units and sensitive instruments by correctly designed and precisely manufactured Lord Mountings and Bonded-Rubber parts.

BURBANK, CALIFORNIA
233 South Third Street

DALLAS, TEXAS
413 Fidelity Union Life Building

PHILADELPHIA 7, PENNSYLVANIA
725 Widener Building

DAYTON 2, OHIO
410 West First Street

DETROIT 2, MICHIGAN
7310 Woodward Ave.

NEW YORK 16, NEW YORK
280 Madison Avenue

CHICAGO 11, ILLINOIS
520 N. Michigan Ave.

CLEVELAND 15, OHIO
Room 811, Hanna Bldg.

LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER *Headquarters for* VIBRATION CONTROL

Industrial Engineering Notes

(Continued from page 74A)

RTMA change its name to the Electronics Manufacturers Association, or some similar name; (2) a division for manufacturers of advanced electronics products be established within the Association, and (3) the Engineering Department be expanded and technical products in the military and commercial sales areas. . . . **Formation of an engineering committee on Internation Components Standards under the Chairmanship of Leon Podolsky, of Sprague Electric Co., was announced recently by Dr. W. R. G. Baker, Director of the RTMA Engineering Department.** The function of this new Committee is to recommend material for international standardization and to review proposals on components submitted by Technical Committee 12-3 of the Internation Electrotechnical Commission. The Committee also will give guidance to the RTMA representative on the IEC. Other members of the Committee are: R. J. Biele, General Electric Co.; Jesse Marsten, Internation Resistance Co.; J. D. Heibel, Erie Resistor Corp.; J. W. Maxwell, P. R. Mallory & Co., Inc.; J. D. Stacy, General Electric Co.; and Fred G. Weber, F. W. Sickles Division.

MATERIALS

Interior Secretary Douglas McKay announced recently that the Bureau of Mines in the Pittsburgh region has started research to find additional sources of germanium for use in radar and other electronic equipment of the Armed Forces. The project is being conducted at the request of and in co-operation with the Signal Corps Engineering Laboratories, Fort Monmouth, N. J. A good method to obtain germanium is to extract it from the ash resulting from the burning of coal; hence, the search is being concentrated in ash pits and smoke stacks of large industrial coal consumers, the Bureau reported. Chemists with the Bureau also plan to make studies of gas producers and blast furnaces as possible sources of germanium. Germanium is now produced in small quantities as a by-product of zinc refining. Annual output is only 6,000 pounds, it was pointed out.

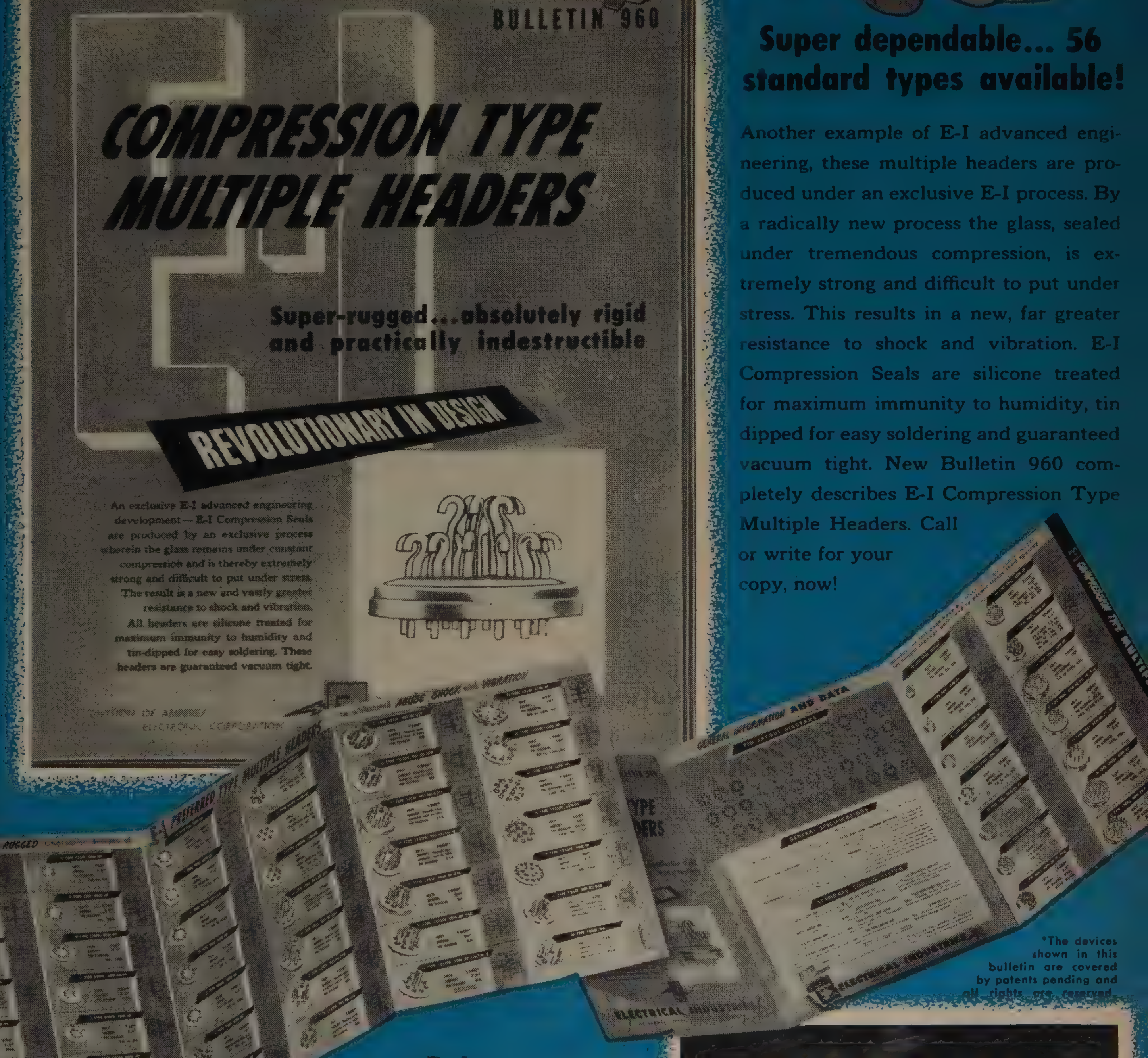
NEW CRYSTAL OSCILLATOR

As part of its program devoted to the improvement of measuring and calibrating standards, the National Bureau of Standards recently developed a crystal oscillator that is small, portable, dependable and accurate over long periods of time. The new oscillator unit was developed by Peter G. Sulzer of the NBS staff. This new crystal oscillator utilizes a junction transistor as the source of driving power for a high-stability quartz crystal unit. All components of the circuit, including the power supply, fit into a metal tube less than 2 inches in diameter and about 7 inches long. With the device it becomes possible to make available a readily-portable, continuously-oscillating frequency standard that may be carried to all parts of the world, NBS re-

(Continued on page 78A)

Opening a New Chapter

E-I COMPRESSION TYPE* MULTIPLE HEADERS



BULLETIN 960

COMPRESSION TYPE MULTIPLE HEADERS

Super-rugged...absolutely rigid and practically indestructible

REVOLUTIONARY IN DESIGN

An exclusive E-I advanced engineering development — E-I Compression Seals are produced by an exclusive process wherein the glass remains under constant compression and is thereby extremely strong and difficult to put under stress. The result is a new and vastly greater resistance to shock and vibration. All headers are silicone treated for maximum immunity to humidity and tin-dipped for easy soldering. These headers are guaranteed vacuum tight.

DIVISION OF AMPEREX ELECTRONIC CORPORATION

SUPER RUGGED
E-I PREFERRED TYPE MULTIPLE HEADERS
... SHOCK and VIBRATION
GENERAL INFORMATION AND DATA
GENERAL SPECIFICATIONS
TYPE
HEADERS
ELECTRICAL INDUSTRIES
E-I COMPRESSION TYPE MULTIPLE

Super dependable... 56 standard types available!

Another example of E-I advanced engineering, these multiple headers are produced under an exclusive E-I process. By a radically new process the glass, sealed under tremendous compression, is extremely strong and difficult to put under stress. This results in a new, far greater resistance to shock and vibration. E-I Compression Seals are silicone treated for maximum immunity to humidity, tin dipped for easy soldering and guaranteed vacuum tight. New Bulletin 960 completely describes E-I Compression Type Multiple Headers. Call or write for your copy, now!

E-I . . . your reliable source for all hermetically sealed terminals—

Hundreds of standard types of multiple headers, octal plug-ins, terminals, color-coded terminals, and end seals for electronic and electrical requirements.

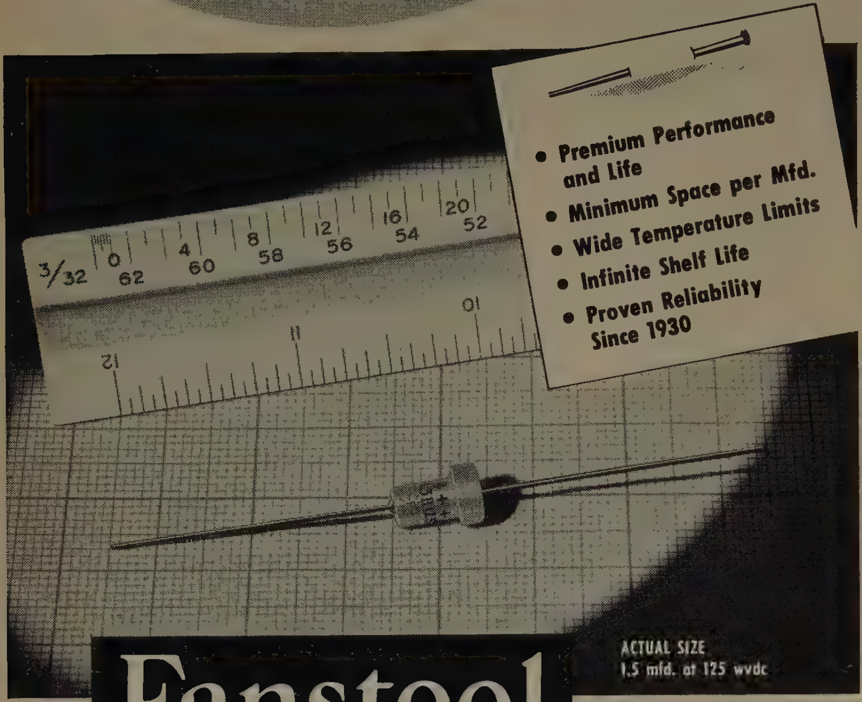
Export Agents:
PHILIPS
EXPORT CORP.
100 East 42nd Street
New York 17, N. Y.

ELECTRICAL INDUSTRIES
DIVISION OF AMPEREX ELECTRONIC CORP.
44 SUMMER AVENUE
NEWARK 4, NEW JERSEY

---

*The devices shown in this bulletin are covered by patents pending and all rights are reserved.

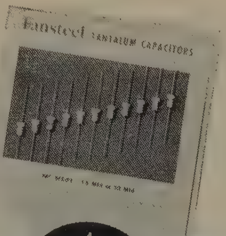
TANTALUM CAPACITORS ARE BASIC
in current electronic trend......



Fansteel
TANTALUM CAPACITORS

Now, through the use of tantalum, new high standards of electrolytic capacitor performance are available. The tantalum oxide film is the most stable dielectric, chemically and electrically, yet discovered. As a result, Tantalum Capacitors offer advantages not found in any other electrolytic type—long life, space saving, wide temperature range, excellent frequency characteristics, no shelf aging.

Tantalum Capacitors are made by Fansteel and other leading capacitor manufacturers. Ask for current information bulletins on Fansteel Tantalum Capacitors.



FANSTEEL METALLURGICAL CORPORATION
NORTH CHICAGO, ILLINOIS, U. S. A.
Tantalum Capacitors . . . Dependable Since 1930

32401C

Industrial Engineering Notes

(Continued from page 76A)

ported. Complete details on the precision transistor oscillator will appear in a future NBS Technical Bulletin.

ELECTRONIC FLOWMETER

A new type of electronic flowmeter, capable of measuring the air currents in a still room or the rapid flow of fluids in pipes, has recently been developed at the National Bureau of Standards. It was designed by Henry P. Kalmus of the NBS staff. This new device utilizes the change in velocity of sound waves as a measure of fluid flow. It has a very fast response and does not obstruct the fluid currents to make the measurement. In addition, the signal-to-noise ratio is sufficiently high to permit the measurement of extremely small velocities. Complete details on the electronic flowmeter appeared in the NBS Technical News Bulletin for February.

CIRCUITRY "PACKAGES"

The National Bureau of Standards has recently developed an improved system of standardized plug-in circuitry "packages" for use in the construction of electronic equipment. This NBS system reportedly is an extension of similar improvements under development by industry. Each new circuit package has a large number of connections brought out to connector pins. A test jack at the top of each package helps locate defective units, making it easy to replace trouble-causing with trouble-free packages. A distinctive feature is the general similarity of most of the circuit stages. A single basic tube circuit is adapted to the great majority of requirements, and the same basic circuit serves as a low-impedance pulse driver, as a flip-flop, and for a number of gating functions. These rapidly repleaceable units, if adopted by manufacturers, promise to combine reduced manufacture and repair costs with improved reliability, the Bureau said. Complete details of the new circuit packages appeared in the NBS Technical News Bulletin for March.

MOBILIZATION

With the view of bridging any gaps which may exist between industry and government, the U. S. Department of the Navy recently sponsored a symposium on electron tube reliability. The one-day session was held February 12 in the Department of Commerce Auditorium, Washington. The program included discussions on the following topics: Design Features of Reliable Tubes, R. E. Moe; Production Aspects of Reliable Tubes, L. B. Davis; and Quality Control Procedures for Reliable Tubes, J. A. Davies, all of the General Electric Co. Specifications for Reliable Tubes, A. J. Heitner; Missile Tube Applications, P. R. Erdle, both of Sylvania Electric Products, Inc. Determining Tube

(Continued on page 80A)

Unexcelled for Accuracy and Dependability

The COLLINS 51J

Communications Receiver

The Collins 51J Communications Receiver in addition to its outstanding performance in the communications field, is being widely used in industrial laboratories as a sensitive and accurate measuring instrument. Write today for complete details and specifications.

Condensed Specifications

FREQUENCY RANGE: .54 to 30.5 megacycles.

CIRCUIT: Double Conversion Superheterodyne.

CALIBRATION: Direct reading in megacycles and kilocycles. One turn of main tuning dial covers 100 kilocycles on all bands.

TUNING: Linear, divided into 30 one-megacycle bands. Each dial division represents one kc.

FREQUENCY STABILITY: Overall stability within 1 kc under normal operating conditions.

SELECTIVITY: 5.5 to 6.5 kilocycles at 6 db down. 17 to 20 kilocycles at 60 db down.

AUDIO OUTPUT: 4 and 600 ohms impedance. 1½ watts at 1000 cps with less than 15% distortion overall. "S" meter may be switched to read audio output.

RF INPUT: High impedance single-ended. Break-in relay mounted internally. Antenna trimmer will resonate input circuit when used with any normal antenna.

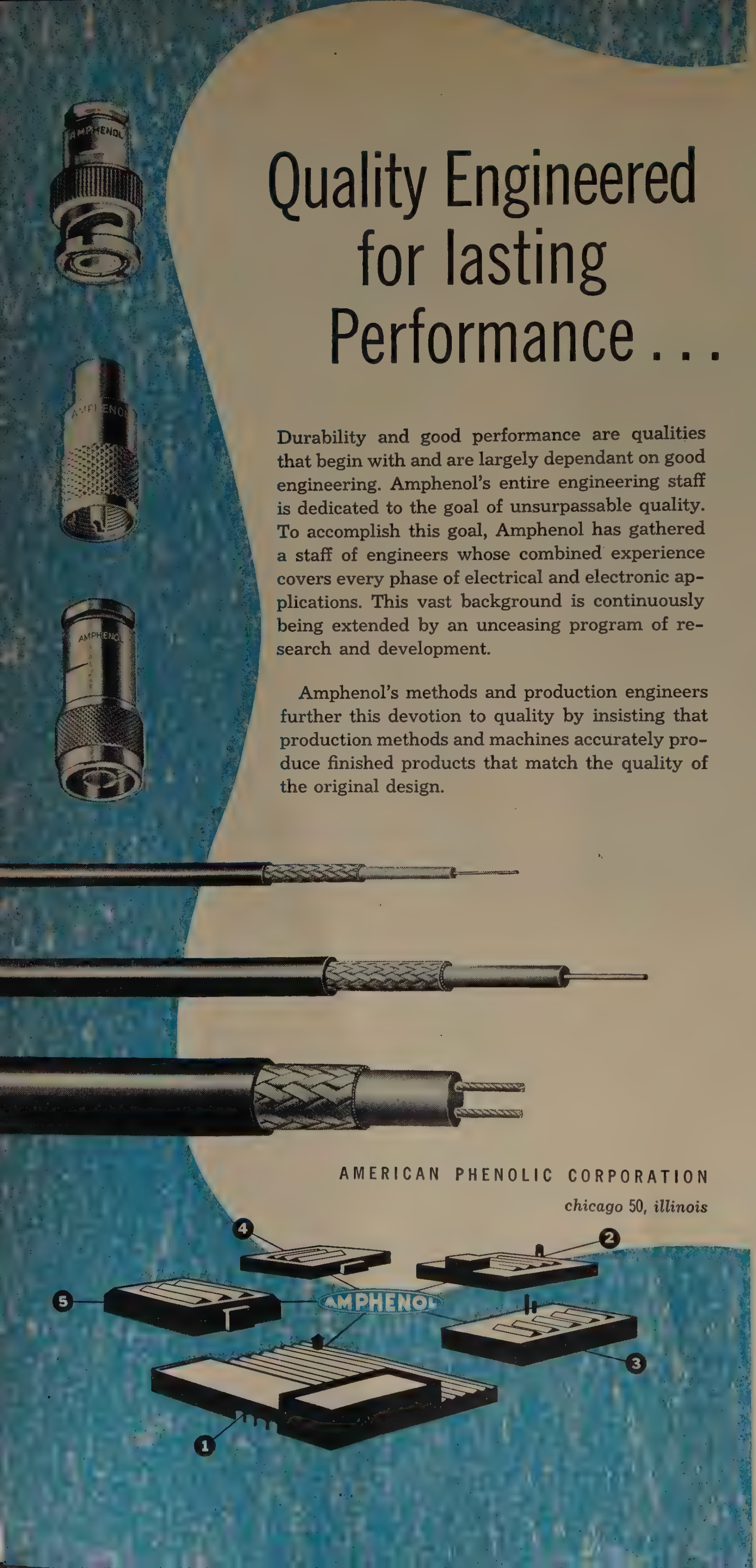
POWER REQUIREMENTS: 85 watts 45/70 cps, 115 volts or 230 volts.

DIMENSIONS: Panel — 10½ inches high, 19 inches wide, notched for rack mounting. Optional metal cabinet — 21-1/8 inches wide, 12-¼ inches high and 13-1/8 inches deep. Speaker available in metal cabinet 15 inches wide, 10-5/8 inches high and 9-1/8 inches deep.

Your inquiries will receive prompt attention

COLLINS RADIO COMPANY

Cedar Rapids, Iowa



Quality Engineered for lasting Performance . . .

Durability and good performance are qualities that begin with and are largely dependant on good engineering. Amphenol's entire engineering staff is dedicated to the goal of unsurpassable quality. To accomplish this goal, Amphenol has gathered a staff of engineers whose combined experience covers every phase of electrical and electronic applications. This vast background is continuously being extended by an unceasing program of research and development.

Amphenol's methods and production engineers further this devotion to quality by insisting that production methods and machines accurately produce finished products that match the quality of the original design.

AMERICAN PHENOLIC CORPORATION
chicago 50, *illinois*

Industrial Engineering Notes

(Continued from page 78A)

Reliability in Operational Equipments, E. F. Jahr; and Statistical Aspects of Tube Reliability, G. R. Herd, of Aeronautical Radio Inc. . . . **The outlay for scientific research and development totaled more than $3.5 billion in 1952, of which almost half was financed by the government, according to a report prepared jointly by the Bureau of Labor Statistics and the Research and Development Board of the Defense Department.** The report, based on a nationwide survey of 2,000 companies and covering some 85 per cent of the total industrial research in 1951, aimed at finding out what industry was doing in the field of research and development. The companies responding to the RDB survey accounted for almost $2 billion of research, with electronics accounting for 27.3 per cent of this amount, or around $500 million. Some 94,000 research engineers and scientists were employed in January 1952 by companies replying to the RDB survey, and 23.2 per cent of them were in the field of electronics. The average research cost per research employee, including both professional and non-professional worker, was $8,900 in 1951. Copies of "Industrial Research and Development" can be had by writing to the Research and Development Board, Department of Defense, Washington 25, D. C.

RESEARCH

The Office of Technical Services, Department of Commerce, has announced the release of its January Bibliograph of Technical Reports. The monthly publication, which lists available reports on scientific and technical research done by the government or with government aid, includes the following of interest to the electronics industry: "Improved Magnetic Materials" (PB 107813), available from the Photoduplication Section, Library of Congress, for $2.75 in microfilm and $7.50 in photostat form. "Improved Magnetic Materials" (PB 107815), Photoduplication Section, Library of Congress, for $2.50 in microfilm and $6.25 in photostat form. "Investigations of Methods of Increasing Life and Capacity of Lead Acid Storage Batteries. I. Preliminary Study of Methods for Evaluating the Corrosion Resistance of Positive Grid Materials" (PB 107841), Photoduplication Section, Library of Congress, Microfilm, $3.75, photostat, $11.25. "Simplified Methods for the Evaluation of Transients in Linear Systems," (PB 107950), Photoduplication Section, Library of Congress, microfilm $2.25, photostat, $5.00. "Television Recording Project" (PB 111-072), available from the Office of Technical Services, Department of Commerce, Washington 25, D. C. for $1.00.

SECTION MEETINGS

AKRON

Student paper competition; January 13, 1953.

"Future Prospects of Ultrahigh Frequency Television," by Dr. Wen Yuan Pan, Radio Corporation of America; January 20, 1953.

ATLANTA

"Communications in Civil Defense," by Stark Totman, Federal Civil Defense Administration; election of officers; January 23, 1953.

BALTIMORE

"Ultrasonics," by Dr. Patrick Conley, Westinghouse Electric Corporation; January 14, 1953.

"Space Travel, When?" by Dr. Wernher von Braun, Ordnance Guidance Missile Center, Huntsville, Ala.; February 12, 1953.

BOSTON

"The Modern Flight Simulator," by W. W. Wood, Jr., Link Aviation, Inc., and "An Automatic Ground Controlled Approach System," by R. C. Kelner; November 20, 1953.

"Physics of Transistor Electronics," by Dr. W. H. Brattain, Bell Telephone Laboratories and "Problems in the Fabrication of Point Contact Transistors," by R. S. Fallows, Sylvania Electric Products, Inc." December 18, 1953.

"A Wide-Range Pulse Generator for Laboratory Applications," by R. W. Frank, General Radio Company, and "Basic Systems for the Measurement and Generation of Phase Relationships," by J. C. Looney, Technology Instrument Corporation; January 22, 1953.

BUFFALO-NIAGARA

"Minaturized Components and Their Applications in Transistor Electronics," by P. S. Darnell, Bell Telephone Laboratories; January 21, 1953.

CENTRAL FLORIDA

"A Novel Electronic Multiplexing System," by P. M. G. Toulon, Radiation, Inc.; November 20, 1952.

"Electric Amplifiers," by Dr. H. E. Hollman, Naval Air Missile Test Center; December 17, 1952.

CHICAGO

"A Review of Transistor Progress in 1952," by R. F. Shea, General Electric Company; January 16, 1953.

CLEVELAND

"The Present Status of Transistor Development," by J. A. Morton, Bell Telephone Laboratories; January 15, 1953.

COLUMBUS

"Advantages and Disadvantages of Big and Small Business," by G. Foster, Industrial Nucleonics; L. Moore, Columbus and Southern Electric Co.; R. W. Masters, The Ohio State University and J. Audi, Line Material Co.; January 13, 1953.

CONNECTICUT VALLEY

"The Problem of High Fidelity Audio Reproduction in the Home," by Dr. L. L. Beranek, Massachusetts Institute of Technology; January 15, 1953.

DALLAS-FT. WORTH

"Switching Circuits for Automatic Control," by William Keister, Bell Telephone Laboratories; February 11, 1953.

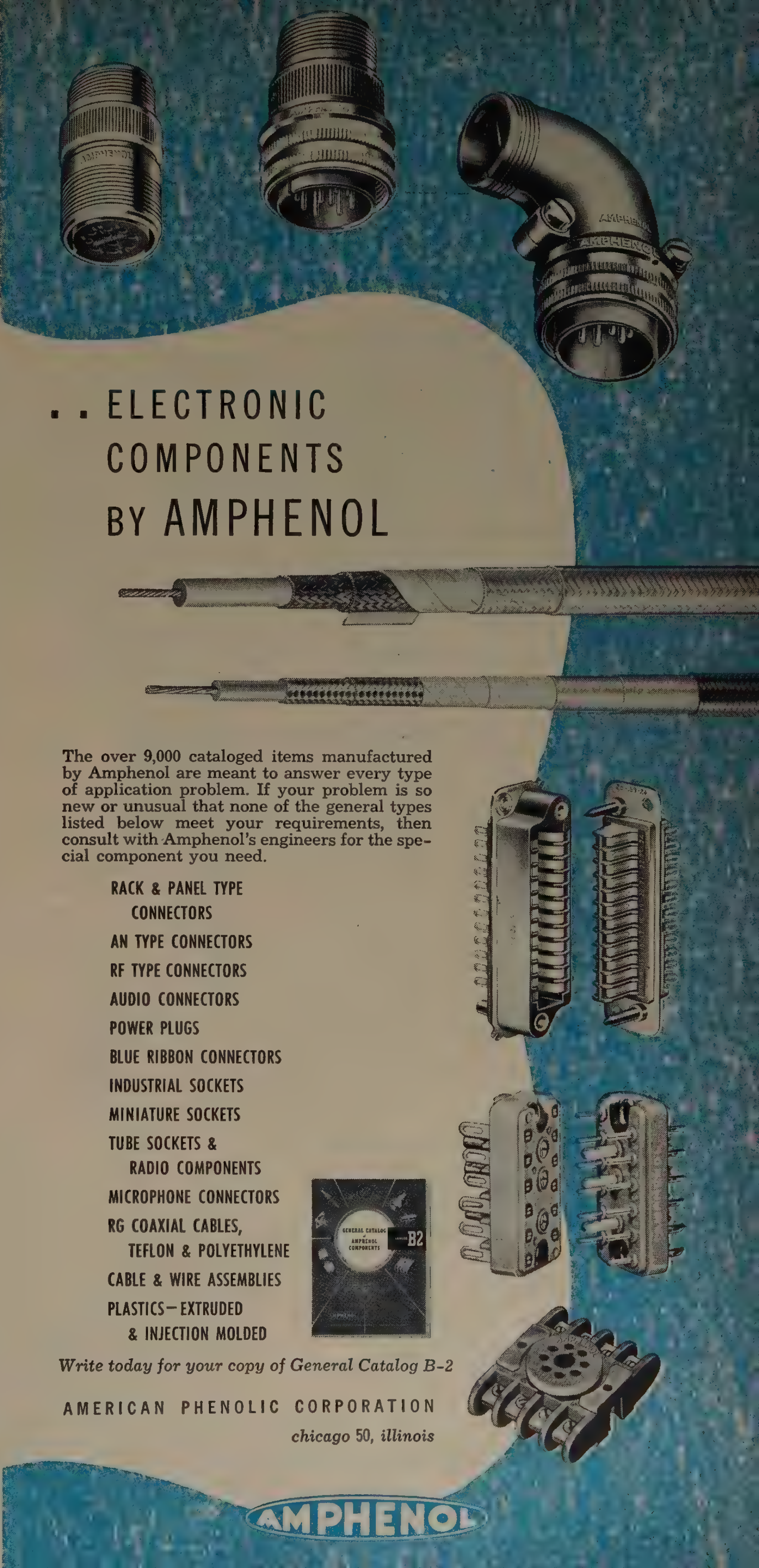
DAYTON

"Servomechanisms," by Donald McDonald, Cook Research Corp.; February 12, 1953.

DES MOINES-AMES

"Highlights and Sidelights of Engineering," by C. A. Scarlott, Editor of "Westinghouse Engineer"; January 27, 1953.

(Continued on page 82A)



. . ELECTRONIC COMPONENTS BY AMPHENOL

The over 9,000 cataloged items manufactured by Amphenol are meant to answer every type of application problem. If your problem is so new or unusual that none of the general types listed below meet your requirements, then consult with Amphenol's engineers for the special component you need.

RACK & PANEL TYPE CONNECTORS
AN TYPE CONNECTORS
RF TYPE CONNECTORS
AUDIO CONNECTORS
POWER PLUGS
BLUE RIBBON CONNECTORS
INDUSTRIAL SOCKETS
MINIATURE SOCKETS
TUBE SOCKETS & RADIO COMPONENTS
MICROPHONE CONNECTORS
RG COAXIAL CABLES, TEFLON & POLYETHYLENE
CABLE & WIRE ASSEMBLIES
PLASTICS—EXTRUDED & INJECTION MOLDED

Write today for your copy of General Catalog B-2

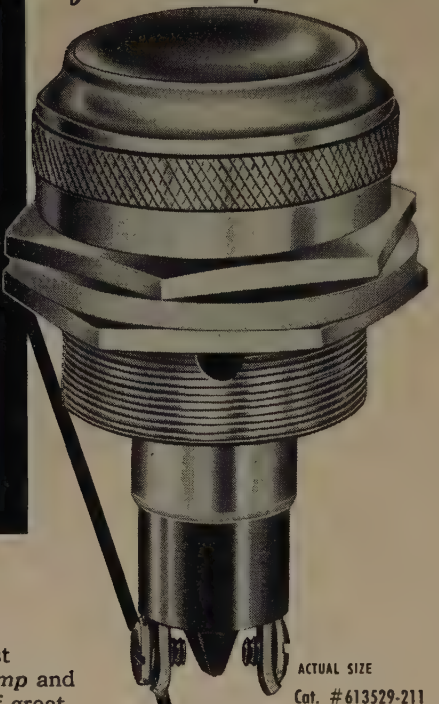
AMERICAN PHENOLIC CORPORATION
chicago 50, illinois

AMPHENOL

DIALCO

for YOUR *product*

WHICH PILOT LIGHT DO YOU NEED?



THE BIG ONE

This Pilot Light Assembly was first made to accommodate the *S-11 lamp* and was intended for use in the cabs of great diesel locomotives.

or

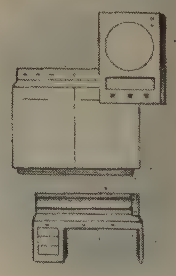
THE LITTLE ONE

The miniaturization program on defense products required the development of this *sub-miniature* light. It is used on communication equipment and aircraft. Midget flanged base bulbs to fit are rated 1.3, 6, 12, and 28 volts.

Dialco HAS THE COMPLETE LINE of INDICATOR and PANEL LIGHTS

Samples to suit your own special conditions and requirements will be sent promptly and *without cost.* Just outline your needs. Let our engineering department assist in selecting the *right lamp* and the *best pilot light* for YOU.

Write for the Dialco HANDBOOK of PILOT LIGHTS



Foremost Manufacturer of Pilot Lights

DIALIGHT CORPORATION

60 STEWART AVENUE, BROOKLYN 37, N. Y. HYACINTH 7-7600

SECTION MEETINGS

(Continued from page 81A)

FT. WAYNE

"Advance Study and Your Engineering Future," by C. J. Poling, Purdue University; February 5, 1953.

HAMILTON

"A Color TV Receiver for N.T.S.C. System," by K. Farr, Westinghouse Electric Corporation; January 26, 1953.

"VHF and UHF Measurement Techniques," by W. A. Cumming, National Research Council; February 16, 1953.

INYOKERN

"Frequency Meter Design Techniques," by Leonard Cutler, Gertch Products, Inc.; January 27, 1953.

KANSAS CITY

"Aurora Magnetic Storms and Radiation," by Dr. R. K. Moore, Sandia Corp.; January 20, 1953.

"Telemetering—Instruments, Systems, Techniques," by M. V. Kieber, Jr., Bendix Aviation Corp.; February 10, 1953.

LITTLE ROCK

"Transistor Manufacturing Techniques," by A. D. Evans, Texas Instrument Co.; January 22, 1953.

"Binaural Recording and Reproduction Sound," by C. G. Barker, Magnecord, Inc.; February 10, 1953.

LONDON

"A Synopsis of Tape Recording Systems and Standards," by G. Robitaille, Chief Engineer, Radio C.F.P.L.; January 20, 1953.

LOS ANGELES

"Remote Recording of Brain Potentials," by Dr. J. A. Gengerelli, Faculty, University of California at Los Angeles; February 3, 1953.

LOUISVILLE

"Application of Radio Isotopes to Medical Research and Therapy," by Drs. M. I. Schwalbe and Morris Nataro; February 12, 1953.

MILWAUKEE

"Pickups and Pre Amps," by N. C. Pickering, Pickering Corp.; January 23, 1953.

"Design of Switching Circuits for Automatic Control," by S. H. Washburn, Bell Telephone Laboratories; February 4, 1953.

MONTREAL

"Modern Glasses and Their Applications," by Dr. W. W. Shaver, Corning Glass Works; November 12, 1952.

"High Fidelity Audio Reproduction," by Dr. J. T. Henderson, Regional Director of Region 8, and R. H. Tanner, Northern Electric Company; December 10, 1952.

NEW YORK

"Recent Industrial Applications of Magnetic Amplifiers," by V. H. Krummenacher, Bogue Electric Manufacturing Company; January 7, 1953.

NORTH CAROLINA-VIRGINIA

"The Next Era in Electronics," by Dr. I. G. Wolff, Radio Corporation of America; January 30, 1953.

OKLAHOMA CITY

"Theory and Application of Transistors," by O. K. Garriott, Student, Oklahoma University; January 13, 1953.

OMAHA-LINCOLN

"New Facilities Now Being Installed in New Building of Lincoln Telephone and Telegraph Company," by C. C. Donley, Lincoln Telephone and Telegraph Company; January 26, 1953.

(Continued on page 84A)

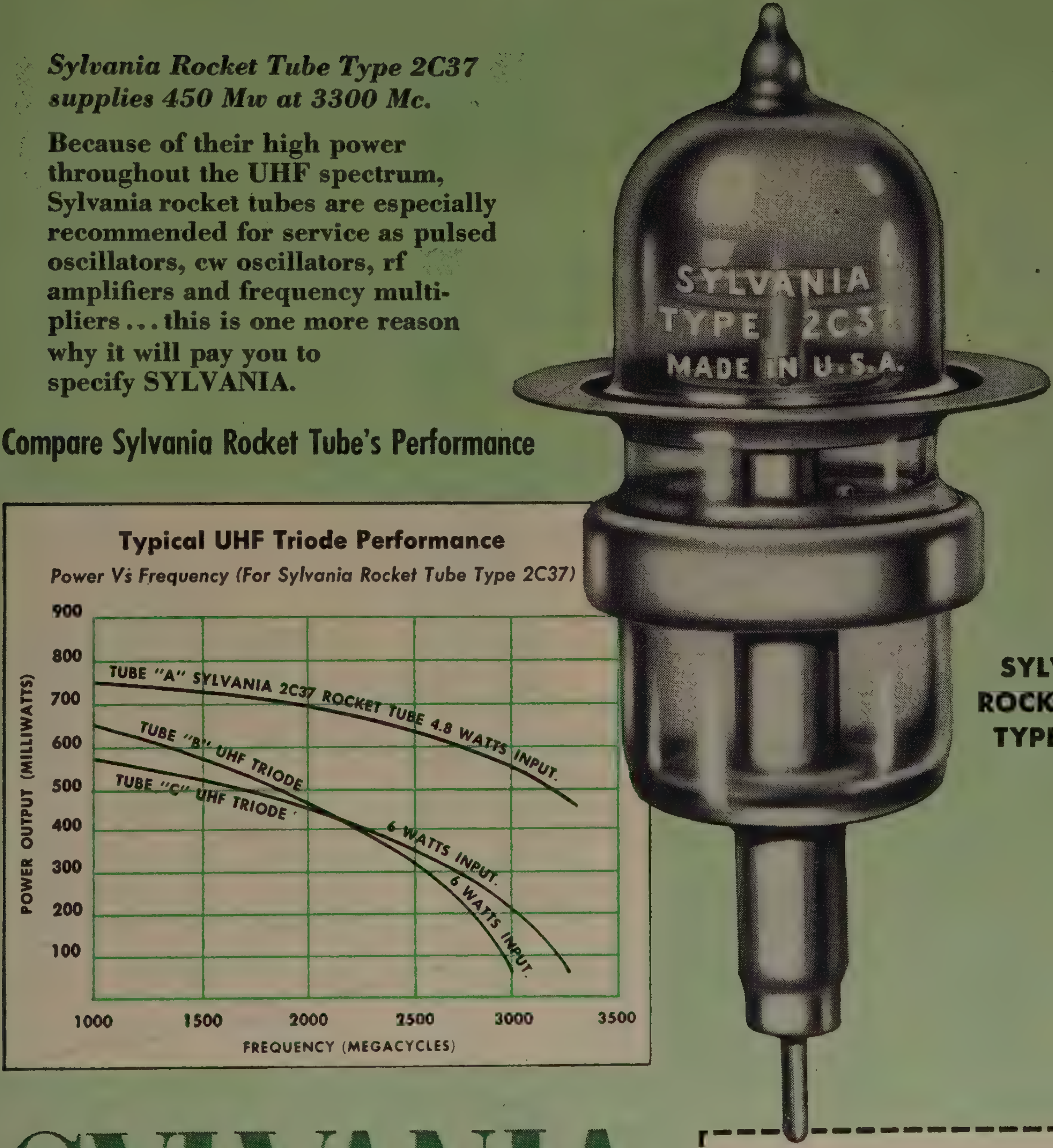
Here's how to get

GOOD USABLE POWER AT UHF

Sylvania Rocket Tube Type 2C37 supplies 450 Mw at 3300 Mc.

Because of their high power throughout the UHF spectrum, Sylvania rocket tubes are especially recommended for service as pulsed oscillators, cw oscillators, rf amplifiers and frequency multipliers . . . this is one more reason why it will pay you to specify SYLVANIA.

Compare Sylvania Rocket Tube's Performance



SYLVANIA ROCKET TUBE TYPE 2C37

SYLVANIA

ELECTRONIC DEVICES; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC TEST EQUIPMENT; FLUORESCENT TUBES, FIXTURES, SIGN TUBING, WIRING DEVICES; LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

Sylvania Electric Products Inc.
Dept. 3E-4504, 1740 Broadway, N.Y. 19, N.Y.

Please send me latest data sheets concerning Sylvania Rocket Tubes

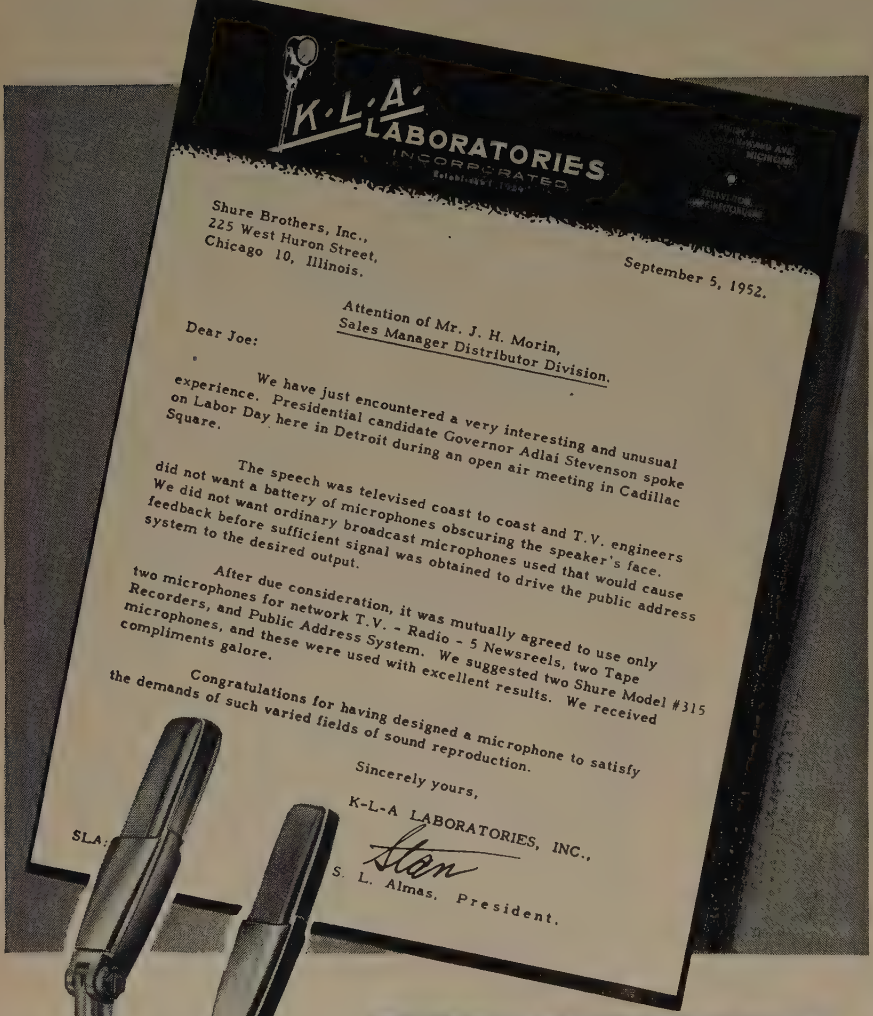
Name______________________________

Street______________________________

City________________Zone_____State________

PROOF of PERFORMANCE

Shure slender Gradient[1] Microphones solve difficult acoustic problem



K·L·A LABORATORIES INCORPORATED

Shure Brothers, Inc.,
225 West Huron Street,
Chicago 10, Illinois.

September 5, 1952.

Attention of Mr. J. H. Morin,
Sales Manager Distributor Division.

Dear Joe:

We have just encountered a very interesting and unusual experience. Presidential candidate Governor Adlai Stevenson spoke on Labor Day here in Detroit during an open air meeting in Cadillac Square.

The speech was televised coast to coast and T.V. engineers did not want a battery of microphones obscuring the speaker's face. We did not want ordinary broadcast microphones used that would cause feedback before sufficient signal was obtained to drive the public address system to the desired output.

After due consideration, it was mutually agreed to use only two microphones for network T.V. - Radio - 5 Newsreels, two Tape Recorders, and Public Address System. We suggested two Shure Model #315 microphones, and these were used with excellent results. We received compliments galore.

Congratulations for having designed a microphone to satisfy the demands of such varied fields of sound reproduction.

Sincerely yours,

K-L-A LABORATORIES, INC.,

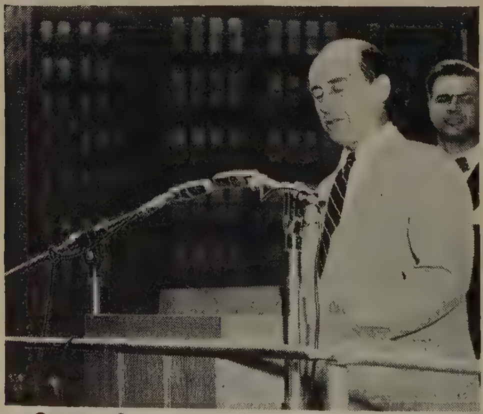
Stan

S. L. Almas, President.

SLA:

"315"
GENERAL PURPOSE
List Price
$75.00

"300"
BROADCAST
List Price
$125.00



Former Governor Stevenson of Illinois, pictured as he addressed Detroit audience on Labor Day, during the 1952 presidential campaign.

SHURE

Shure Patents Pending

SHURE BROTHERS, Inc. ★ **Microphones and Acoustic Devices**

225 West Huron Street, Chicago 10, Illinois • Cable Address: SHUREMICRO

SECTION MEETINGS

(*Continued from page 82A*)

PHILADELPHIA

"The Human Centrifuge," by T. F. Pierce and C. E. Brooks, Aviation Medical Acceleration Laboratory, Naval Air Development Center; November 6, 1952.

"Field Emission Microscopy," by Dr. E. A. Muller, Faculty, Pennsylvania State College; January 8, 1953.

"Principles and Applications of Magnetic Amplifiers," by Dr. H. L. Goldstein, Bell Telephone Laboratories; February 4, 1953.

PITTSBURGH

"Generalized Servomechanism Evaluation," by W. M. Kaufman, Student, Carnegie Institute of Technology; February 9, 1953.

SAN FRANCISCO

"Electronics in the Oil Industry," by D. J. Pompeo, Shell Development Company; E. E. Harison, Standard Oil of California; V. N. Smith, Shell Development Co. and Dr. D. Hull, California Research Corp. Moderator, O. J. M. Smith. January 14, 1953.

SYRACUSE

"Solid State Luminescence," by Dr. Williams, General Electric Company; February 5, 1953.

TOLEDO

"Single-Sideband Transmission by Envelope Elimination and Restoration," by L. R. Kahn, consulting firm; February 12, 1953.

TORONTO

"High Efficiency TV Horizontal Sweep Systems" and "Dissipation Determination," by C. E. Torsch, General Electric Company; January 26, 1953.

TULSA

"Electronics in Aviation," by W. J. Weldon, American Airlines, Inc.; January 21, 1953.

VANCOUVER

Student's Night. Speakers: H. J. Goldie, B. P. Hildebrand and H. Palmer, Students, University of British Columbia; January 19, 1953.

WASHINGTON

"Microwave Propagation on Dielectric Rods in Ferromagnetic Media," by A. G. Fox, Bell Telephone Laboratories, Inc. and "A New Transistor for High Frequency Use," by R. I. Wallace, Bell Telephone Laboratories, Inc.; January 15, 1953.

"The Transmission of Speech by Narrow Band Signals," by W. G. Tuller and H. M. Williams, Melpar, Inc.; February 9, 1953.

WILLIAMSPORT

"The Design of Receiving Tubes for Use in UHF TV Service," by L. R. Maguire and R. W. Slinkman and E. H. Boden, Sylvania Electric Products Inc.; January 28, 1953.

SUBSECTIONS

LANCASTER

"Practical Television Antennas for Ultra-High Frequency Reception," by E. O. Johnson, RCA-Victor; January 14, 1953.

LONG ISLAND

"Low Temperature Physics," by Dr. C. A. Swenson, Massachusetts Institute of Technology; January 13, 1953.

NORTHERN NEW JERSEY

"Theseus, A Maze-Solving Machine," by Dr. Claude Shannon, Bell Telephone Laboratories, Inc.; January 14, 1953.

(*Continued on page 86A*)

RAYTHEON electrostatically focused Picture Tubes take the *full design center max. rating* of 18,000 volts with adequate "high line" reserve.

Tested At 22,000 Volts
No Voltage Breakdown
Long Life Guns
Long Life Screens
Superior 100% Area Focusing

RAYTHEON®
Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division — for application information call

Newton, Mass. Bigelow 4-7500 ● Chicago, Ill. NAtional 2-2770 ● New York, N. Y. WHitehall 3-4980 ● Los Angeles, Calif. Richmond 7-5524

RAYTHEON MAKES ALL THESE:

RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES

WHEN TEMPERATURES RUN HIGH

In the design of electrical and electronic circuits where operating temperatures run fairly high, it is extremely important that the voltage ratings of components such as capacitors conform exactly to name-plate designations.

P-C Capacitors, designed for temperatures ranging from minus 90° C. to plus 200° C., depending upon the type, are guaranteed to operate without voltage derating at temperatures specified.

You can design your circuits around P-C Capacitors with complete assurance of their performance at specified temperatures.

P-C CAPACITORS OFFER YOU

Smaller Size	Lighter Weight
Higher Temperatures	High Resistance
Low Absorption	Low Power Factor
Extreme Voltage Range	High Current Ratings
Maximum Capacitance Stability	Higher Frequency of Resonance

Your inquiries invited. Ask for complete catalog on your company letterhead.

Plastic Capacitors, Inc.

Plastic Film Capacitors • High Voltage Power Packs • Pulse Forming Networks
2511 W. Moffat St., Chicago 47, Illinois

SECTION MEETINGS

(Continued from page 84A)

PALO ALTO

"Basic Concepts of Information Theory," by Dr. B. M. Oliver, Hewlett-Packard Company; January 20, 1953.

ROME

"Miniaturization of Electronic Equipment," by Gustave Shapiro, National Bureau of Standards; January 19, 1953.

WINNIPEG

"Technical Aspects of TV," by J. E. Hayes, C.B.C.; December 4, 1952.

STUDENT BRANCH MEETINGS

AGRICULTURAL & MECHANICAL COLLEGE OF TEXAS, IRE-AIEE BRANCH

"Can Machines Think?" By Mr. Keister, Bell Telephone Laboratories; February 9, 1953.

UNIVERSITY OF AKRON, IRE-AIEE BRANCH

Student Papers: "A Two Speed Synchronous Motor and Its Controls," by Curtis Ivey, "Power Factor Meter," by Raymond Miller, and "A.M. Detector," by Robert Savoy, Students, University of Akron; January 13, 1953.

UNIVERSITY OF ALBERTA, IRE-AIEE BRANCH

"Telephone Connections in Alberta," by Mr. Schmidt, Alberta Research Council; January 19, 1953.

"Industrial Welding," by T. J. Jacobs, Jacobs Welding Engineering School; February 2, 1953.

BRITISH COLUMBIA, IRE-AIEE BRANCH

General Meeting; February 6, 1953.

BROWN UNIVERSITY, IRE-AIEE BRANCH

General Business Meeting; December 9, 1953.

Field Trip to WPRO-Providence; February 5, 1953.

Film, "Radio Frequency Heating"; February 18, 1953.

CALIFORNIA STATE POLYTECHNIC COLLEGE, IRE BRANCH

"The Fundamentals of Transistors and their Applications," by Walter Sterling, Consolidated-Vultee Aircraft Company; January 14, 1953.

UNIVERSITY OF DENVER, IRE-AIEE BRANCH

General Meeting; February 5, 1953.

STATE UNIVERSITY OF IOWA, IRE BRANCH

Films, "Navy and National Bureau of Standards Research and Development Laboratories of California" and "United States Naval Ordinance Test Station—Inyokern"; November 5, 1952.

Open Discussion on "Seminar Field Trips"; November 12, 1952.

"Underground Transmission Power Cables," by W. J. Anciaux and "380 KV Overhead Transmission System of Sweden," by E. H. Berentsen, both students, University of Iowa; November 19, 1952.

"SUI Radio Amateur Club," by J. E. Frankhauser, Faculty, State University of Iowa; December 3, 1952.

"Work Experiences at Collins Radio Co." by W. J. Streib, Faculty, State University of Iowa; December 17, 1952.

(Continued on page 90A)

Another new member of the CLEVELITE* family

Torkrite Tubing in foreground, enlarged to show detail.

TORKRITE . . . Clevelite EE Internally Threaded and Embossed Tubing ELIMINATES TORQUE AND STRIPPING PROBLEMS!

A few of many
ADVANTAGES:

TORKRITE'S re-cycling ability is unmatched. After a maximum diameter core has been re-cycled in a given form a reasonable number of times, a minimum diameter core can be inserted and measured at 1" oz. approx.

TORKRITE has no hole nor perforations through the tube wall. This eliminates possibility of cement leakage locking the cores.

TORKRITE allows use of lower torque as it is completely independent of stripping pressure.

With TORKRITE torque does not increase after winding, as the heavier wall will not tend to collapse and bind the core.

Available in lengths 3/4" to 3 1/8" to fit a 1/4-28 core.

★ ★ ★

Electronic engineers find that TORKRITE, this newly designed and constructed Coil Form, has definite advantages over all other types requiring the use of threaded cores.

TORKRITE is one of the many items of CLEVELITE . . . a complete line of tubing for coil forms, collars, bushings, spacers, tubes and other items.

CLEVELITE has long been giving continuous satisfaction because of its dependable performance, uniformity and close tolerances.

Consult our Research and Engineering Laboratory. It is at your service.

WHY PAY MORE? FOR THE BEST . . . CALL CLEVELAND!

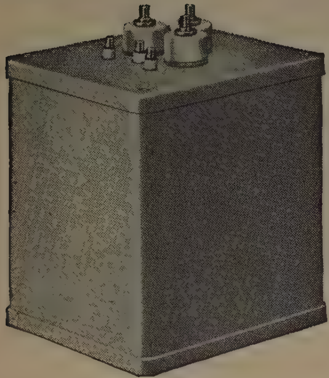
* Reg. U. S. Pat. Off.

The CLEVELAND CONTAINER Co.
6201 BARBERTON AVE. CLEVELAND 2, OHIO
PLANTS AND SALES OFFICES at Plymouth, Wisc., Chicago, Detroit, Ogdensburg, N.Y., Jamesburg, N.J.
ABRASIVE DIVISION at Cleveland, Ohio
CANADIAN PLANT: The Cleveland Container, Canada, Ltd., Prescott, Ontario

REPRESENTATIVES

NEW YORK AREA	R. T. MURRAY, 604 CENTRAL AVE., EAST ORANGE, N. J.
NEW ENGLAND	R. S. PETTIGREW & CO., 62 LA SALLE RD., WEST HARTFORD, CONN.
CHICAGO AREA	PLASTIC TUBING SALES, 5215 N. RAVENSWOOD AVE., CHICAGO

Quality
COMES
FIRST



• If performance and long life are the primary factors in your application of transformers, then submit your specifications to Acme Electric. Quality comes first in every Acme Electric transformer.

ACME ELECTRIC CORPORATION
444 WATER STREET • CUBA, N.Y.
In Canada: ACME ELECTRIC CORP. LTD.
50 North Line Rd. Toronto, Ont., Canada

Acme ACME Electric
TRANSFORMERS

HYCOR
TYPE 4200

Sound Effects Filter

This unit has been developed to meet present day requirements for compactness. The filter requires only 3½ inches of rack space.

Features . . .

- **LOW HUM PICKUP** through the use of toroid coils. The unit may be used in circuits having signal levels as low as —40 dbm without the necessity for taking special precautions against hum pickup.
- **LOW DISTORTION:** The filter may be used at levels up to plus 20 dbm with negligible intermodulation distortion.
- **RELIABILITY:** All capacitors and inductors are hermetically sealed for lifetime service. Aging effects are negligible.

General Specifications . . .

DIMENSIONS: Standard rack panel, slotted, 3½" high. Maximum depth 7½".
CONTROLS: Low frequency cutoff selector knob, high frequency cutoff selector knob, on-off key.
RANGES: Both low and high frequency cutoff controls cover 100, 250, 500, 1000, 2000, 3000, 4000 and 5000 cycles.
ATTENUATION: Approximately 16 db, per octave on both high and low frequency cutoff points.
IMPEDANCE: 500/600 ohms, in-out.
FINISH: Engraved panel finished in medium gray baked enamel. (Special colors available upon request.)
The filter has standard input and output jacks located on the front panel in addition to the terminal block at the rear.

11423 VANOWEN ST., NORTH HOLLYWOOD, CALIFORNIA HYCOR Company, Inc. **SUnset 3-3860**

Manufacturers of Precision Resistors, Toroid Inductors and Electric Wave Filters

REPRESENTATIVES:
Jack Beebe, 5707 W. Lake Street, Chicago, Illinois
George E. Harris & Co., Box 3005, Municipal Airport, Wichita, Kansas
Marvin E. Nulsen, 5376 E. Washington St., Indianapolis 19, Indiana
Burlingame Associates, 103 Lafayette Street, New York City

For further information contact your nearest Hycor representative or write for Bulletin S

STUDENT BRANCH MEETINGS

(Continued from page 86A)

"Direct Projection Television," by D. W. Thomas and "Sinusoidal Pulse Generator," by J. E. Madison, students, State University of Iowa; January 7, 1953.

"Electroencephalograph," by J. W. Baum, Student, State University of Iowa and open Discussion on "Student Engineers Lounge Plans"; January 14, 1953.

"Walkie-Talkie," by E. J. Tillo, Student, State University of Iowa, and open Discussion on "Possible Solutions to Practical Problems Encountered in Measurements in the Field of Medical Research"; January 21, 1953.

"Bell Telephone Laboratories," by H. A. Wells, Bell Telephone Laboratories; January 28, 1953.

LOUISIANA STATE UNIVERSITY, IRE-AIEE BRANCH

"Recent Developments in Power," by D. L. Chesnut, General Electric Company; November 12, 1952.

Film and General Meeting; December 9, 1952.

"Traffic Signals," by J. A. Loupe and "The Applications of A.C. Series Motors in Locomotives," by F. V. Warner; December 12, 1952.

"Engineering at Oak Ridge," by Gibson Morris, Carbide and Carbon Chemicals Company of Oak Ridge, Tenn.; January 6, 1953.

UNIVERSITY OF MAINE, IRE BRANCH

"Development of the Traveling Wave Tube," by Roger White, Federal Telecommunications Laboratories; February 10, 1953.

UNIVERSITY OF MARYLAND, IRE-AIEE BRANCH

Binaural Sound Demonstration by Frank McIntosh, McIntosh Laboratories and Capt. Robert Hathaway, USAF; November 5, 1952.

"Transistors," by Dr. William Deurig, Johns Hopkins Institute; December 3, 1952.

"Telemetering of the V-2 Rocket," by Representative of Johns Hopkins Institute; January 7, 1953.

"The Control System of the Viking Rocket," by N. E. Felt, Jr., Glenn L. Martin Company; February 11, 1953.

UNIVERSITY OF MASSACHUSETTS,
IRE-AIEE BRANCH

"The Use of Copper in the Electrical Industry," (Illustrated with two films), by I. T. Hook, American Brass Company; January 14, 1953.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY,
IRE-AIEE BRANCH

Election of officers and business meeting; January 20, 1953.

MICHIGAN COLLEGE OF MINING & TECHNOLOGY,
IRE-AIEE BRANCH

"My Recent Tour of Duty in the West Pacific as Navy Radio Operator," by D. I. Fales, Student, Michigan College of Mining and Technology; January 13, 1953.

"Radio Station Management," by A. Payne, Radio Station WHDF; January 28, 1953.

"Technical Operating Procedure at WHDF," by George Burgan, Radio Station WHDF; February 10, 1953.

NEWARK COLLEGE OF ENGINEERING, IRE BRANCH

Tour of RCA Electron Tube Plant in Harrison, N. J.; February 3, 1953.

COLLEGE OF THE CITY OF NEW YORK, IRE BRANCH

Election of officers; January 8, 1953.

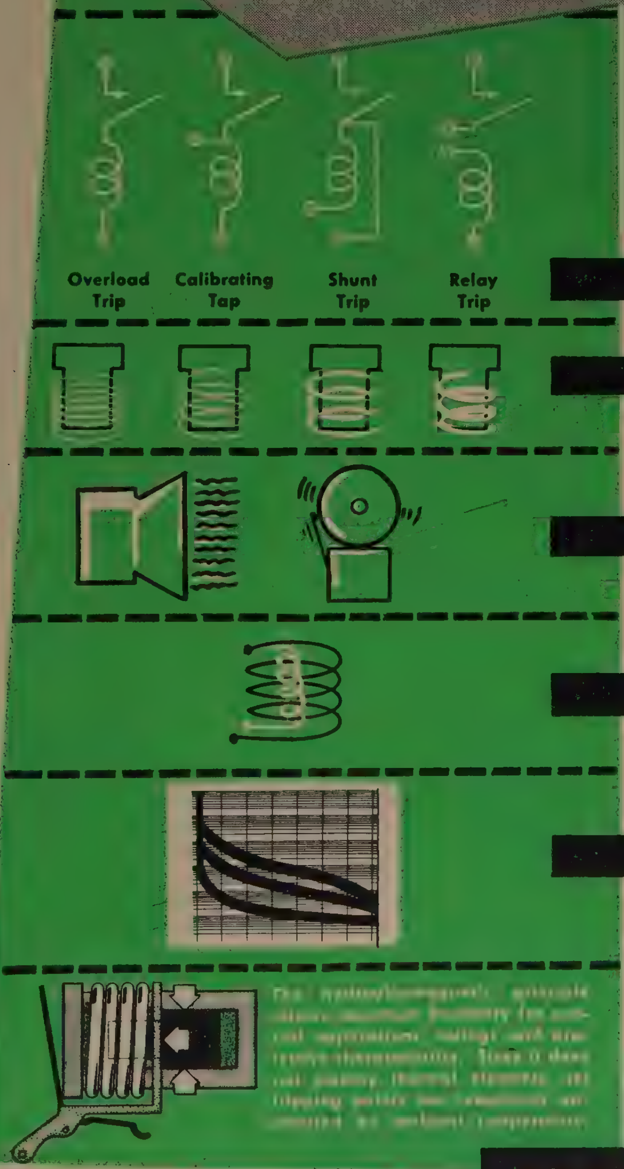
(Continued on page 92A)

Need Something Special in a Circuit Breaker?

Perhaps the problem of protection or control of your equipment can be solved by a HEINEMANN Circuit Breaker.

Operating on a hydraulic-magnetic, solenoid principle . . . with or without inverse time delay . . . HEINEMANN Circuit Breakers offer almost unlimited possibilities in fulfilling standard or special functions.

Your requests for special information will receive prompt attention.



[illegible]

SPECIAL CIRCUITS

SPECIAL OR FRACTIONAL RATINGS

Close tolerances of protection may be obtained by precise, fractional rating between 10 milliamperes and 100 amperes.

ALARM CONTACTS

Alarm contacts are available on certain models to permit visual or audible signal on tripping of circuit breaker.

DUAL RATINGS

A single circuit breaker may be furnished with two coils for operation on different currents.

SPECIAL RESPONSE CURVES

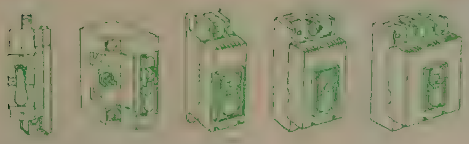
Time vs. per cent overload response curves may be selected to match protection characteristics to the requirements of your product.

WRITE FOR BULLETIN SW

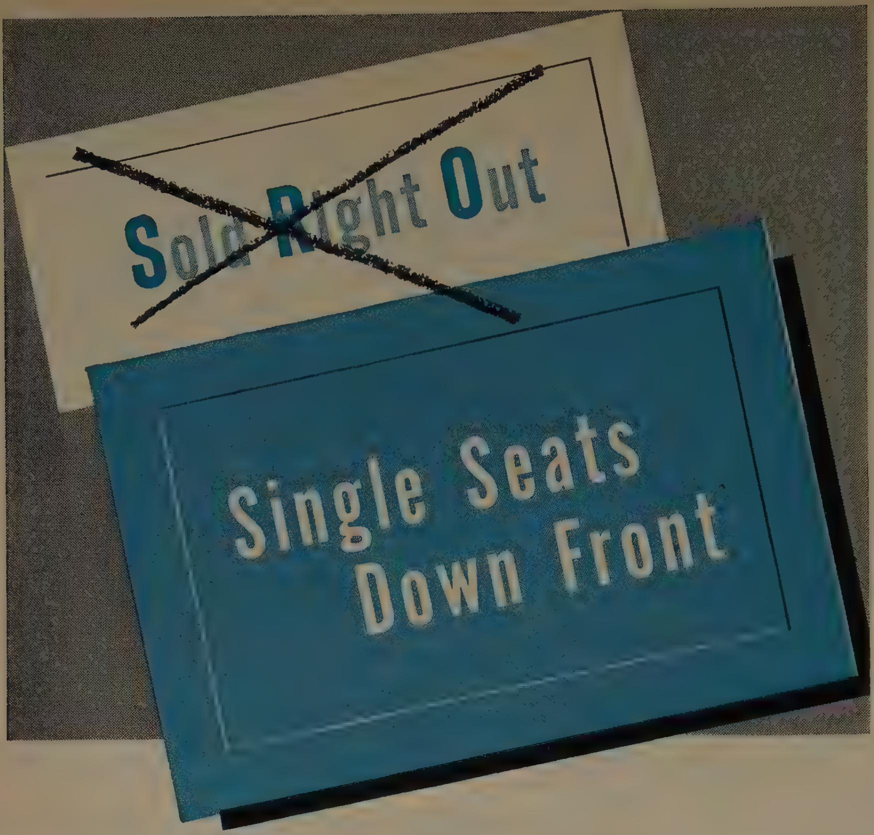
HEINEMANN ELECTRIC CO.

154 PLUM STREET TRENTON 2, N. J.

HEINEMANN Circuit breakers



HEINEMANN Circuit Breakers...One, two and three pole...10 milliamps to 100 amperes



Our previous series of advertisements in this publication explained, in theatrical parlance, that our design and production facilities were pretty well "sold out" by the requirements of our present customers.

Now, we are happy to say (because we enjoy making new friends) that some of the heat has been taken off, and we are able to announce "Limited seating available"—as they say at the box office.

We shall be happy to talk with you about your present and/or future needs.

L. H. Terpening Company
DESIGN • RESEARCH • PRODUCTION
Microwave Transmission Lines and Associated Components
16 W. 61st St. • New York 23, N. Y. • Circle 6-4760

STUDENT BRANCH MEETINGS

(Continued from page 90A)

New York University (Eve. Div.), IRE-AIEE Branch

"Recent Developments in TV Picture Tubes," by Robert Scott, Dumont Laboratories, Inc.; January 23, 1953.

North Dakota State College, IRE-AIEE Branch

General meeting; December 3, 1952.

Films, "Atomic Power" and "Atomic Energy"; January 26, 1953.

Northwestern University, IRE-AIEE Branch

Student paper competition and talk by Dr. J. F. Calvert, Faculty, Northwestern University; January 13, 1953.

Films; January 20, 1953.

Film, "Electrical Proving Ground"; January 27, 1953.

Ohio State University, IRE-AIEE Branch

Field trip to National Electric Coil Company; January 29, 1953.

Field trip to Ohio State University Cyclotron Laboratory; February 12, 1953.

Oklahoma Agricultural & Mechanical College, IRE-AIEE Branch

"Low Voltage Metal Inclosed Switchgear for Industrial Power Distribution," by F. R. Summers, Westinghouse Electric Corp.; February 9, 1953.

University of Pennsylvania, IRE-AIEE Branch

Election of officers; February 5, 1953.

Rensselaer Polytechnic Institute, IRE-AIEE Branch

"Recent Developments of Klystron Tubes," by C. E. Rich, Sperry Gyroscope Company; February 10, 1953.

Rutgers University, IRE-AIEE Branch

"Patent Law and the Engineer," by Morton Amster, counselor of law; February 10, 1953.

Business meeting; February 17, 1953.

The University of Southern California, IRE-AIEE Branch

"The Instrument Story," by J. E. Berring, Weston Instrument Corp.; February 10, 1953.

Stanford University, IRE-AIEE Branch

Field trip to Lenkurt Electric Company; February 13, 1953.

University of Texas, IRE-AIEE Branch

"Cybernetics," by W. T. Guy, Professor of Applied Mathematics; February 2, 1953.

University of Toledo, IRE-AIEE Branch

"Helpful Hints in TV Servicing," by D. F. Davey and E. E. Swartz, Students, University of Toledo; December 5, 1952.

University of Toronto, IRE-AIEE Branch

"Sound System for Opera Performances," by Mr. Goldin, Consulting Engineer; November 14, 1952.

"Professional Organization," by Roy Harmer, Lecturer at Ryerson Institute of Toronto; December 5, 1952.

"Computers," by V. G. Smith, Faculty, University of Toronto; January 16, 1953.

Tufts College, IRE-AIEE Branch

Business meeting; February 18, 1953.

(Continued on page 93A)

KILOVOLTS for KLYSTRONS

A NEW
UNIVERSAL
KLYSTRON
POWER
SUPPLY
FOR
MICROWAVE
OSCILLATORS

- Operates all low power commercial klystrons.
- Positive or negative grid operation.
- Widest modulation frequency range.
- Beam voltage: Regulated continuously variable over the ranges of 300 to 1500 volts at 65 ma. or to 3600 volts at 25 ma.
- Repeller voltage: Direct reading continuously variable over the range of −20 to −750 volts.
- Grid volts: Variable bias is provided by front panel control. "Safety-Lock" precludes tube damage.
- Modulation: Square wave, saw tooth, external or highly stable c-w operation.

WHEN YOU BUY—SPECIFY
THE PRD MODEL 801-A

Polytechnic RESEARCH
& DEVELOPMENT COMPANY, Inc
202 TILLARY STREET, BROOKLYN 1, NEW YORK
Offices: 55 JOHNSON ST., BROOKLYN 1, N. Y.

ZOPHAR
---WAXES
---COMPOUNDS

Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types; radio, television, etc. Cold flows from 100°F. to 285°F. Special waxes non-cracking at —76°F. Compounds meeting Government specifications plain or fungus resistant. Let us help you with your engineering problems.

ZOPHAR MILLS, INC.
112-130 26th Street,
Brooklyn 32, N. Y.

STUDENT BRANCH MEETINGS

(Continued from page 92A)

University of Utah, IRE-AIEE Branch

"Electrical Engineering in the Bureau of Reclamation," by G. R. Derrick, U. S. Bureau of Reclamation; December 4, 1952.

"What Industry Expects from Engineers," by S. S. Kistler, Dean, University of Utah College of Engineering; January 22, 1953.

"Underwater Sound and Detection Devices," by Dr. Fred Huber, Naval Electronic Laboratory; January 29, 1953.

Utah State Agricultural College
IRE Branch

"Forest Service Communication," by Francis Woods, U. S. Forest Service; January 28, 1953.

"Television on a Mountain Top or the Rise and Fall of KSL T.V.," by V. E. Clayton, KSL Television; February 11, 1953.

University of Virginia, IRE-AIEE Branch

"Design of Broadcast Consolettes for Announcer Use," by L. F. Goeller, Jr., Student, University of Virginia; February 17, 1953.

Virginia Polytechnic Institute,
IRE-AIEE Branch

Business meeting; January 13, 1953.
Business meeting; January 20, 1953.
Business meeting; February 10, 1953.

University of Washington, IRE-AIEE Branch

"The Northwest Power Problem," by F. D. Robbins, Faculty, University of Washington; January 15, 1953.

General meeting and film, "Watts in Glass"; January 29, 1953.

Wayne University, IRE-AIEE Branch

"Instrumentation of Resistance Welding Machine Schedules," by A. R. Satullo, Instructor, Wayne University; January 9, 1953.

MEMBERSHIP

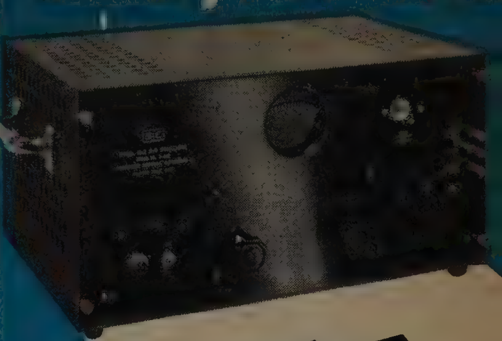
The following transfers and admissions were approved to be effective as of April 1, 1953:

Transfer to Senior Member

Alexander, W. G., 6 Maguire Rd., Cochituate, Mass.
Ayer, W. E., 95 Hilltop Dr., San Carlos, Calif.
Bargellini, P. L., 15 Yale Sq., Morton, Pa.
Bauer, B., 1089 Forest Ave., Palo Alto, Calif.
Berglund, E. B., 56 Roosevelt St., Garden City, L. I., N. Y.
Ebert, J. E., 478 Whitehall St., Lynbrook, L. I., N. Y.
Franklin, C. S., 228 Lewiston Rd., Dayton 9, Ohio
French, H. A., 16 Howard Pl. Waldwick, N. J.
Guida, J. A., 2904 Newcastle Ave., Silver Spring, Md.
Gulden, E. V., 140 Oak Knoll Dr., Dayton 9, Ohio
Haggerty, P. E., 5322 Falls Rd., Dallas 9, Tex.
Hassler, E. B., 5879 N. Kolmar Ave., Chicago 30, Ill.

(Continued on page 94A)

When you need a



Quality Oscillator

SIE

MODEL M-2 OSCILLATOR
is your answer

low distortion... wide range

The unique SIE oscillator circuit which has no lower limit to its possible frequency of oscillation is responsible for the excellent low frequency performance of the Model M-2 and other SIE oscillators.

SPECIFICATIONS

Range: 1 cps to 120,000 cps.
Calibration: Within 1½% plus 1/10 cycle
Output circuits: 20 volts or 20 millamps and 1 volt at 300 ohms constant impedance
Amplitude stability: Plus or minus ½ db

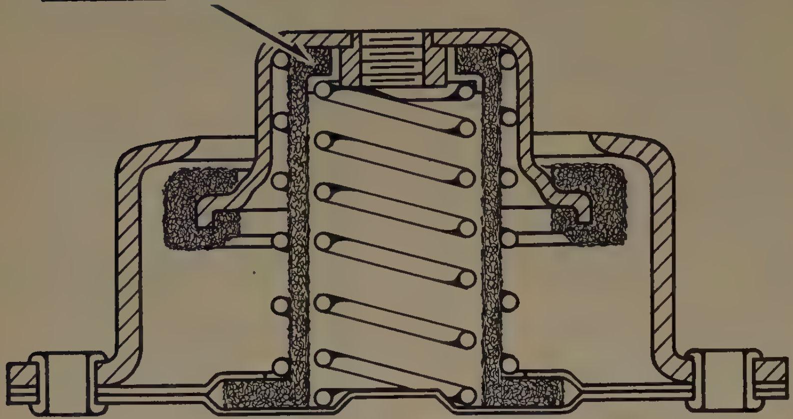
UNDESIRED VOLTAGES

Power Supply Noise: Less than 1/100% of output signal
Power Line Surge: Less than 1/10% of output signal
Harmonic Distortion: Less than 2/10% from 20 cps to 15,000 cps. Less than 1% at all other frequencies
Microphonic Noise: Less than 1/100% of output signal

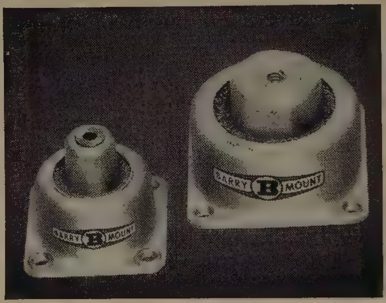
SOUTHWESTERN INDUSTRIAL
ELECTRONICS COMPANY

SHOCK AND VIBRATION NEWS

HERE'S THE SECRET



. . . of a NEW
wire-mesh isolator
that won't change
on the job!



The new Type 7630 and Type 7640 ALL-METL Barrymounts have been specifically designed to eliminate loss of efficiency due to damper packing. Previous wire-mesh unit vibration isolators exhibited a definite loss of damping efficiency after a period in actual service, because the wire-mesh damper tended to pack. These new unit Barrymounts have eliminated this difficulty, because load-bearing spring returns damper to normal position on every cycle.

- Very light weight — helps you reduce the weight of mounted equipment.
- Hex top — simplifies your installation problems.
- High isolation efficiency — meets latest government specifications (JAN-C-172A, etc.) — gives your equipment maximum protection.
- Ruggedized — to meet the shock-test requirements of military specifications.
- Operates over a wide range of temperatures — ideal for guided-missile or jet installations.

Compare these unit isolators with any others — by making your own tests, or on the basis of full details contained in Barry Product Bulletin 531. Your free copy will be mailed on request.

Free samples for your prototypes are available through your nearest Barry representative.

THE BARRY CORP.
716 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS
SALES REPRESENTATIVES IN
Atlanta Baltimore Chicago Cleveland Dallas Dayton Detroit Los Angeles Minneapolis New York
Philadelphia Phoenix Rochester St. Louis San Francisco Seattle Toronto Washington

MEMBERSHIP

(*Continued from page 93A*)

Heister, C. F., 3200 Federal Office Bldg., Kansas City 6E, Mo.
Holbrook, R. O., 405 Southwest Dr., Silver Spring, Md.
Ivers, J. H., 552 S. Border Rd., Winchester, Mass.
Jaeger, J. H., 361 Oakland Park Ave., Columbus 14, Ohio
Kadet, J., 19 Shute Path, Oak Hill Pk., Newton, Mass.
King, S., Electrical Engineering Department, University of Tennessee, Knoxville, Tenn.
Lundquist, C. R., 6686 DeAnza Ave., Riverside, Calif.
McKesson, L. J., 405 Upper Blvd., Ridgewood, N. J.
McRae, A. H., 1623 Hearthstone Dr., Dayton 10, Ohio
Meyer, E. G., 45 Cumberland Ave., Great Neck, L. I., N. Y.
Millard, A. M., Southern New England Telephone Co., 227 Church St., New Haven 6, Conn.
Murphy, C. H. S., Bureau of Aeronautics Representative, McDonnell Aircraft Corp., Box 516, St. Louis 3, Mo.
Pickens, D. H., 7518 S. Thomas Ave., Bridgeview, Chicago 38, Ill.
Podolsky, L., 18 Lexington Pkwy., Pittsfield, Mass.
Powell, D. S., 3415—38 St., N.W., Washington 16, D. C.
Richardson, G. A., Electrical Engineering Department, Iowa State College, Ames, Iowa
Stubbs, W., Telecommunications Department, Kuala Lumpur, Malaya
Thulin, C. W., Bell Telephone Laboratories, Inc., Murray Hill, N. J.
Van Valkenburg, M. E., Engineering Hall, University of Utah, Salt Lake City 1, Utah
Weinschel, B. O., 10015 Woodland Dr., Silver Spring, Md.
Wieland, E. S., 1203 Salem Ave., Dayton 6, Ohio
Wilson, R. T., 426 Essex Dr., Lexington Park, Md.
Witkin, E., 6801 N. 11 St., Philadelphia 26, Pa.

Admission to Senior Member

Ball, K. E., 2619 General Bradley, N. E., Albuquerque, N. Mex.
Bundy, C. W., USS MacKenzie (DD836), Fleet Post Office, San Francisco, Calif.
Cederbaum, I., Box 1, Kiryat-Motzkin, Israel
Coapman, J. W., 240 Laurie St., Eau Gallie, Fla.
Comins, A. W., 1708 Windsor Ave., Lancaster, Pa.
Fenyves, F. L., Basle (Switzerland) 75 Austr., Basle, Switzerland
Foster, L. W., 43 Cottage Hill Rd., Glens Falls, N. Y.
Hasley, A. D., 53 Cherry La., Basking Ridge, N. J.
Hawthorne, E. I., Moore School of Electrical Engineering, 200 S. 33 St., Philadelphia 4, Pa.
Hearn, R. B., 463 West St., New York 14, N. Y.
Holborn, F., 15 Eastwood Pl., Cedar Grove, N. J.
McPherson, J. C., 590 Madison Ave., New York 22, N. Y.
Means, W. J., 35 Whittredge Rd., Summit, N. J.
Nichols, N. B., Manager of Research Division, Raytheon Manufacturing Co., Waltham 54, Mass.
Plummer, D., 3116 Elm Ave., Manhattan Beach, Calif.
Raney, J. J., 140 W. Center College St., Yellow Springs, Ohio
Schisel, J., 105 New England Ave., Apt. F-8, Summit, N. J.
Schneider, S. S., Canadian Westinghouse Co., Ltd., Longwood Rd., Hamilton, Ont., Canada
Scott, J. E., 325 S. Central Ave., Fairborn, Ohio
Sheldon, J. L., 179 Dodge Ave., Corning, N. Y.
Sutinen, C. P., 31 W. Third St., Moorestown, N. J.
Thomas, J. E., Jr., 49 Kendal Common Rd., Weston 93, Mass.
Wynn, R. T. B., British Broadcasting Corp., Broadcasting House, London W.1, England

(*Continued on page 98A*)

Xb BAND 3/4" x 1 1/2" W
PLAIN FLANGES UG150/U & UG150/U
Waveflex
Titeflex
MICROWAVE COMPONENTS
● designed, built, and inspected to insure superior performance
SMALL X BAND 1/2" x 1" WAVEFLEX
Waveflex
S BAND 1 1/2" x 3" WAVEFLEX
Waveflex
PLAIN FLANGES
L BAND 6 1/2" x 3 1/4" WAVEFL
RIGID
Waveflex
YOURS...WITH OUR COMPLIMENTS

This New, 12-Page Microwave Components Data Book

Send Today!

SEND FOR YOUR COPY

Contains diagrams and tables of sizes and types—detailed Government specifications for rigid and flexible waveguides—manufacturing and testing operations. If you're working on electronic contracts, this Handbook belongs on your desk. The coupon brings you as many copies as you need.

Titeflex

TITEFLEX, INC.
511 Frelinghuysen Avenue
Newark 5, N. J.

Please send me without cost ______ copies of your new Microwave Components Data Book.

NAME______________________
TITLE______________________
FIRM______________________
ADDRESS______________________
CITY______________ZONE______STATE______

For the first time

FLEXIBLE WAVEGUIDE with power rating equal to that of rigid guide!

BANK ON Airtron inc. for

HIGH POWERED FLEXAGUIDE®

for RADAR applications

Broad-band FLEXIBLE assemblies guaranteed to a V.S.W.R. of less than 1.10—attenuation equal to that of brass rigid waveguide—yet none of the essential advantages of flexible plumbing sacrificed to achieve this new type of waveguide! Performance is what counts; let us show you . . .

NOW you can route your R.F. circuits into previously impossible channels, without power, V.S.W.R. or attenuation penalties

Write for data sheets on new, high powered FLEXAGUIDE

PEAK POWER AT BREAKDOWN MEGAWATTS
1.5
1.4
1.3
1.2
1.1
1.0
RIGID RG-52/U
PULSE WIDTH = 2.5 μ SEC. PRF-360 PULSES PER SEC. EXTERNAL RADIATION Co^{60}
AIRTRON FLEXAGUIDE AHR-116
1 2 3 4 5 6 7 8 9 10
TEST RUN NUMBERS

Airtron inc.

20 East Elizabeth Ave., Linden, New Jersey

BRANCH OFFICES

CHICAGO ST. LOUIS DAYTON DALLAS BALTIMORE LOS ANGELES SEATTLE

MEMBERSHIP

(Continued from page 94A)

Transfer to Member

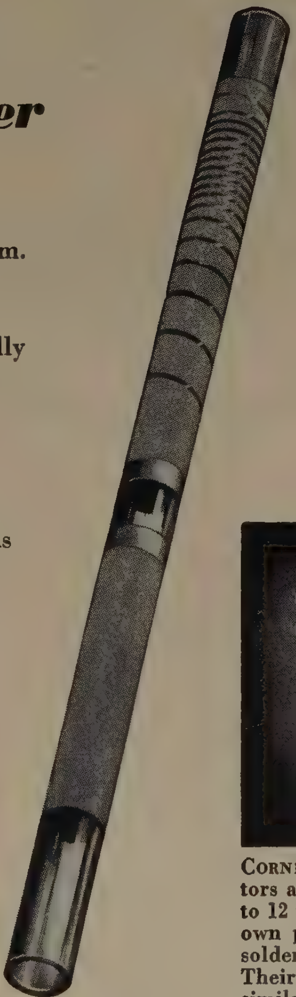
Attack, H. G., 579 James St., S., Hamilton, Ont
Canada
Bailey, W. R., Texas Instruments, 6000 Lemmo
Ave., Dallas 9, Tex.
Bauer, R. E., U. S. Naval Postgraduate Schoo
Monterey, Calif.
Bennett, R. C., 2239 Marconi Ave., Sacramento 2
Calif.
Brock, F. A., 5422 Druid La., Dallas 9, Tex.
Cook, M. F., 6307 Tecumseh Pl., College Park, M
D'Arcy, E. W., 7045 Osceola Ave., Chicago 31, Il
Finn, D. L., School of Electrical Engineerin
Georgia Institute of Technology, Atlant
Ga.
Gagnon, L. A., Box 166, 235 Second Ave., Po
Alfred, Que., Canada
Hansen, H. M., 1314 Walden Rd., Walnut Cree
Calif.
Healey, D. J., III, Shawan Rd., Cockeysville, M
Helland, J. C., 24 Flannery Ave., Poughkeepsi
N. Y.
Hensel, W. G., 265 Washington Ave., Chatham
N. J.
Khouri, A. S., Centralab, a Division of Globe
Union, Inc., 900 E. Keefe Ave., Milwauke
11, Wis.
McCarter, G. B., 8310—16 St., Apt. 116, Silve
Spring, Md.
Moore, A. D., 604 East 23 Ave., Vancouver 1
B. C., Canada
Nelson, R. T., 94 Pershing Ave., Valley Strea
L. I., N. Y.
North, R. C., Jr., 2844 East 26, Tulsa, Okla.
Nylin, M. E., 454 Douglas Ave., Toronto 12, Ont
Canada
Page, F. E., Jr., 1116 Post St., Houston, Tex.
Post, R. F., 1004 N. Kedzie Ave., Chicago 51, Il
Quint, A. S., 55 Lee St., Cambridge 39, Mass.
Richman, H. R., Box 658, R.F.D. 2, Fairfax, Va.
Schroeder, K. R., 43-28 Byrd St., Flushing 55, L. I
N. Y.
Scroggins, C. M., 4154 Prescott Ave., Dallas 9, Te
Shainis, M. J., 99 Featherbed La., New York, 5
N. Y.
Snow, J. E., Far East Air Logistic Force, APO 32
c/o Postmaster, San Francisco, Calif.
Stachiewicz, B. R., 926 E. Hastings St., Vancouve
4, B. C., Canada
Stewart, G. L., 25 Thursfield Cresc., Toronto 1
Ont., Canada
Villadamigo, R. D., Apartado Nacional No. 76
Barranquilla, Colombia, S. A.
Stewart, J. L., 315 Apt. No. 6 Stanford Villag
Stanford, Calif.
Swierczak, P. C., 6716 Harvey Ave., Merchantvil
8, N. J.
Trebby, F. J., 4128 S. Garfield St., Spokane 3
Wash.
Weis, C. F., 57 N. Bromfield Rd., Dayton 9, Oh

Admission to Member

Allen, D. H., 2180 Colorado Ave., Santa Monic
Calif.
Atchison, F. S., 6197 Palm Ave., Riverside, Cal
Brumbach, J. F., 9736 Johanna Ave., Frankl
Park, Ill.
Brunson, R. A., R.F.D. 1, 10 Elm St., Florha
Park, N. J.
Byrnes, W. P., Teletype Corp., 1400 W. Wrigh
wood Ave., Chicago 14, Ill.
Cammer, H. R., 231 Argyle Rd., Brooklyn 18, N.
Campbell, A. A., 4812 Southern Ave., S. E., Albu
querque, N. Mex.
Cornell, W. A., 27 Forest Rd., Murray Hill, N.
Dawson, L. R., 432 A Kalama St., Lanikai, Hawa
Doxey, W. L., 239 Albert Pl., Elberon, N. J.

(Continued on page 100A)

Why Motorola uses Corning Metallized Glass Inductances in new UHF converter



UHF converters present a tough design problem. Not only must they tune an unusually broad band, stability is extremely important.

Motorola solved their problem with a specially designed CORNING metallized glass inductance. As can be seen from the illustration, the tuning elements are a combination of distributed capacitance and inductance. The variable pitch winding tailors the unit to the desired tracking curve. One end of the turns is broadened to provide termination surface. The accuracy and rigidity of the glass assure stable, noiseless tuning.

The exceptionally high electrical stability and low temperature coefficient of CORNING metallized glass inductances are a result of the integral contact of the fired-on metallizing with the dimensionally stable glass coil forms. Drift is negligible, even under unusually variable ambient temperatures. High Q is inherent.

CORNING metallized glass inductances may well be the answer to your problem. All it takes to find out is a letter to us. Our engineers are ready to go to work for you.

CORNING Metallized Glass Inductances can be designed to fit your requirements exactly. Uniform, variable or double pitch windings are as easily manufactured as are fixed tuned, permeability tuned or permeability tuned inductance-trimmer combinations. Once a design has been approved, it can be accurately duplicated on automatic machinery to very close tolerances and in any quantity.

CORNING Metallized Glass Trimmer Capacitors are available in standard types from .3 to 12 u.u.f. or can be designed to meet your own particular needs. They are simple to solder, rugged and easy to tune critically. Their superior electrical characteristics are similar to CORNING inductances.

Corning Glass Works

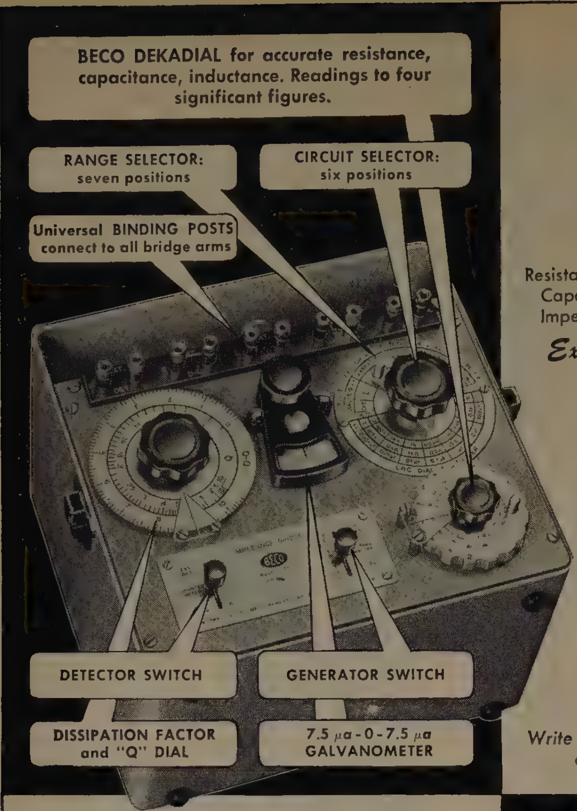
New Products Division · CORNING, N. Y.

Corning means research in Glass

Corning Glass Works
Department NP-3 • Corning, New York

Please send me literature on
☐ Metallized Glass Inductances, ☐ Metallized Glass Trimmer Capacitors.

Name .... Title ....
Company ....
City .... Zone .... State ....


BECO DEKADIAL for accurate resistance, capacitance, inductance. Readings to four significant figures.
RANGE SELECTOR: seven positions
CIRCUIT SELECTOR: six positions
Universal BINDING POSTS connect to all bridge arms
DETECTOR SWITCH
GENERATOR SWITCH
DISSIPATION FACTOR and "Q" DIAL
7.5 μa-0-7.5 μa GALVANOMETER

BECO

IMPEDANCE BRIDGE

Wide Range

Resistance: 1 milliohm to 11 megohms
Capacitance: 1 mmf to 1100 mfs.
Impedance: 1 mh to 1100 henrys

Exceptional Accuracy

Resistance: ±0.1%
Capacitance: ±0.25%
Inductance: ±1.0%

◆

SHOWN
MODEL 250-C1
$340

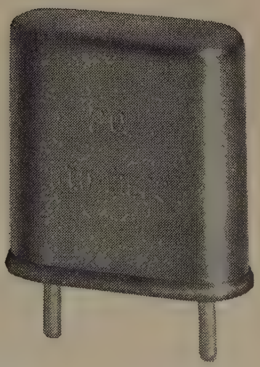
9"x11"x11" over-all. Convenient operation from battery, or from AC power lines with Beco accessory amplifier

◆

Write to factory for literature and analysis of your needs.

BROWN ELECTRO-MEASUREMENT CORP.

4635 S. E. HAWTHORNE BLVD.
PORTLAND 15, OREGON



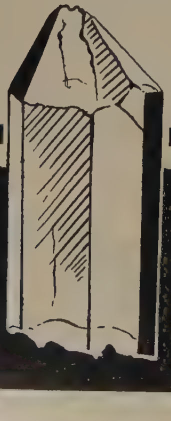
FOR
FREQUENCY
Stability
IN
Mobile
EQUIPMENT . . . .

make sure your crystals are made by Standard Piezo.
For years, our Crystals have been standard as original equipment with leading manufacturers and for replacement purposes by large operators of mobile equipment.

Precise, accurate, Standard Piezo Crystals are available for *ALL* types of mobile communication equipment.

Request catalog R for complete details.

Standard Piezo
COMPANY
CARLISLE, PENNSYLVANIA



MEMBERSHIP

(Continued from page 98A)

Ellen, S. T., Smith Ave., R.F.D. 7, Baltimore 9, Md.
Fraser, F. S., 1777 West Third Ave., Vancouver, B. C., Canada
Fricks, W. H., 909 Borum Pl., Oklahoma City 10, Okla.
Gaunt, R. P., 8430 Lennox Ave., Van Nuys, Calif.
Godsey, W. J., 1023 Eastern Ave., Baltimore 21, Md.
Harden, C. M., 78 Pierce Rd., Watertown, Mass.
Heimlich, I. R., 2209 Graham St., Grand Prairie, Tex.
Horn, C. H., Rm. 210, 1401 Arch St., Philadelphia 2, Pa.
Hunter, W. O., 2732 N. Serrano Ave., Los Angeles 27, Calif.
Johnston, W. A., Jr., Fairchild Guided Missiles Division, Wyandanch, L. I., N. Y.
Jose, R. S., R.F.D. 2, Rancocas Woods, Mt. Holly, N. J.
Keating, J. J., 3112 Chadwick Dr., Los Angeles 32, Calif.
Kelton, M. R., Box 146, Montreal, Que., Canada
Knowlton, R. F., R.F.D. 5, 1502 E. Alta, Wichita 15, Kans.
Low, A. R., 578 Broadway Ave., Toronto 17, Ont., Canada
Mentzer, P. K., 3201 Wooster Rd., Rocky River 16, Ohio
Minidis, A., 9544 Lenore St., Detroit 28, Mich.
Morris, H. N., 213 Beverly Rd., Cocoa, Fla.
Newnan, H. L., 420 Market St., San Francisco 11, Calif.
Perry, F. M., 2000 Pyle Rd., Schenectady 3, N. Y.
Rae, J. R., 171 Riverview Ave., Tarrytown, N. Y.
Ralph, J. T., 2027 S. Newton Ave., Park Ridge, Ill.
Ross, R. M., Sylvania Electric Products, Inc., 1740 Broadway, New York 19, N. Y.
Sperber, A. O., 7407—64 Pl., Glendale 27, L. I., N. Y.
Stelmak, J. P., Westinghouse Electric Corp., Box 284, Elmira, N. Y.
van der Lee, A. C., 707M Lima, Buenos Aires, Argentina
Warner, F. C., 12 High St., Bethel, Conn.
Zomber, G. L., 22 Dartmouth St., Garden City, L. I., N. Y.

The following elections to Associate grade were approved to be effective as of March 1, 1953:

Adair, R. J., 19 Proctor Blvd., Hamilton, Ont., Canada
Adams, H. E., Qtrs. W 15, NRL, CBA, Chesapeake Beach, Md.
Adamson, W. V., 306 W. Mayfield Blvd., San Antonio, Tex.
Albert, D. E., 918 Hamilton Ave., Latrobe, Pa.
Allard, L. C., Jr., Box 3024, Wright-Patterson AFB, Dayton, Ohio
Allen, D. F., 7 Alcott St., Allston 34, Mass.
Ambrogi, J. N., Jr., 319 Lincoln Ave., Lansdowne, Pa.
Anderson, W. L., 127—96 St., San Antonio 4, Tex.
Anlage, J. J., 52 Winding Way, Haddonfield, N. J.
Avella, P. S., 2155 N. Mobile Ave., Chicago 39, Ill.
Barr, F. M., 1380 North Ave., Elizabeth 3, N. J.
Barr, H. J., 813 E. Seventh St., Plainfield, N. J.
Bass, C. F., 350 Saxon Rd., Latham, N. Y.
Bazydlo, H. A., 4737 Plumer St., Detroit 9, Mich.
Beaver, M. W., 712 Crown St., Brooklyn 13, N. Y.
Beck, C., 5838 Cedar Ave., Philadelphia, Pa.
Becker, H. R., 20-04 Woodbine St., Ridgewood, L. I., N. Y.
Behringer, N. C., 29 Deer La., Wantagh, L. I., N. Y.
Bellingham, L. C., Natvar Corp., Box 67, Rahway, N. J.

(Continued on page 101A)

MEMBERSHIP

(Continued from page 100A)

Benway, R. E., 1641 Old Phila Pike, Lancaster, Pa.
Bernard, D. T., 126 Cedar St., Wethersfield, Conn.
Blicher, A., 535 W. 110 St., New York 25, N. Y.
Bloom, I., 3509 Virginia Ave., Baltimore 15, Md.
Bolay, C. E., c/o Two-Way Radio Communication Co., 505 N.W. Second, Oklahoma City, Okla.
Bowe, J. J., 6 Bunton St., East Milton 86, Mass.
Brumley, C. H., 183 Collingsworth Dr., Rochester 10, N. Y.
Buchinger, M. J., 74 N. Fourth St., Paterson, N. J.
Bunnell, N. R., 1410 Delaware Ave., Wyomissing, Pa.
Burr, G. S., Instron Engineering Corp., 2 Hancock St., Quincy 71, Mass.
Busteed, P. E., 25 Irving Ter., Cambridge, Mass.
Callegari, P. B., 12331 S. Yale Ave., Chicago 28, Ill.
Campani, L. M., 116 W. Merrick Rd., Freeport, L. I., N. Y.
Cape, K. E., 3040 S. Emerald Ave., Chicago, Ill.
Carroll, L. R., 925 E. Baseline Rd., Claremont, Calif.
Cervantes, H. T., Jr., E73, ER Division, U.S.S. Tarawa (CVA-40), c/o FPO, New York, N. Y.

Chase, W. R., 368 Burkedale Blvd., San Antonio 10, Tex.
Chiappinelli, B. A., 10790 Calvin St., Culver City, Calif.
Chinn, F. T., 2917 West 71 St., Kansas City 13, Mo.
Cichanowice, H. J., 550 Deeds Ave., Dayton 4, Ohio
Clark, A. R., 25 Wanamassa Point Rd., Wanamassa, N. J.
Cohen, F., 330 W. Johnson St., Philadelphia 44, Pa.

(Continued on page 102A)

Over 85% of the torque wrenches used in industry are

STURTEVANT
TORQUE WRENCHES
Read by Sight, Sound or Feel.

- Permanently Accurate
- Practically Indestructible
- Faster—Easier to use
- Automatic Release
- All Capacities

in inch ounces . . . inch pounds . . . foot pounds (All Sizes from 0-6000 ft. lbs.)

Every manufacturer, design and production man should have this valuable data. Sent upon request.

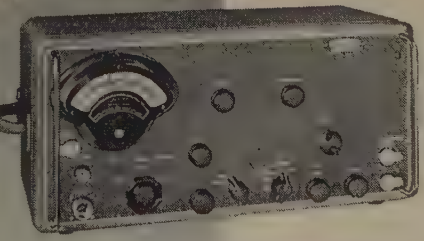
P. A. STURTEVANT CO.
ADDISON QUALITY ILLINOIS

STANDARD
Radio Interference and Field Intensity
MEASURING EQUIPMENT
Complete Frequency Coverage—14kc to 1000 mc!

VLF
14kc to 250kc
Commercial Equivalent of AN/URM-6B.
Very low frequencies.

HF
150kc to 25mc
Commercial Equivalent of AN/PRM-1A. Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies. Has B.F.O.

VHF
15mc to 400mc
Commercial Equivalent of TS-587/U.
Frequency range includes FM and TV Bands.



UHF
375mc to 1000mc
Commercial Equivalent of AN/URM-17.
Frequency range includes Citizens Band and UHF color TV Band.

These instruments comply with test equipment requirements of such radio interference specifications as MIL-I-6181, MIL-I-16910, PRO-MIL-STD-225, ASA C63.2, 16E4, AN-I-24a, AN-I-42, AN-I-27a, MIL-I-6722 and others.

STODDART AIRCRAFT RADIO Co., Inc.
6644-C Santa Monica Boulevard, Hollywood 38, California

IT'S
HARVEY
FOR PROMPT
"OFF-THE-SHELF" DELIVERY

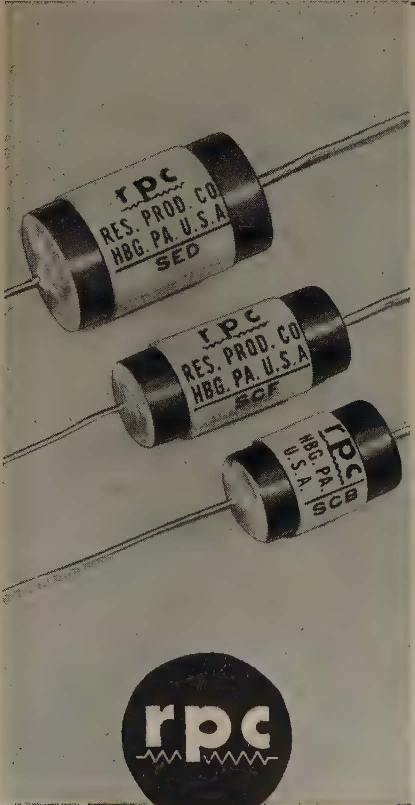
Whether it's equipment, components or other electronic requirements, you will always find them in Harvey's extensive stocks, ready for immediate delivery to you anywhere.

Harvey's twenty-five years of service to the industry are your assurance of understanding 'know-how' and complete dependability.

WRITE
PHONE
or WIRE

Telephone
LUxemberg 2-1500

HARVEY
RADIO COMPANY, INC.
103 West 43rd St., New York 36, N. Y.



MINIATURE
HERMETICALLY SEALED
PRECISION WIRE WOUND

Where the utmost in permanence and stability are required, Type S has proven successful. Unaffected by extreme temperature cycling, aircraft altitude or salt water immersion.

Wound on steatite forms, solder sealed into steatite jackets. Vacuum tested. Long leakage path. Can be wired into circuit. Self supporting. Low coefficient alloys used.

Standard resistance tolerance 1%, ½% and ¼% also available. Write for complete information and engineering data.

Type	Dimensions		Jan-R-93	Power Rating		Resistance	
	Len.	Diam.		Jan.	Comml.	Min. ohm	Max. meg
SCB	9/16	11/32	——	—	watts ¼	2.0	0.15
SCF	13/16	11/32	RB51A	¼	watts ½	1.0	0.40
SED	13/16	15/32	RB51A	¼	watts ½	0.5	1.0

rpc

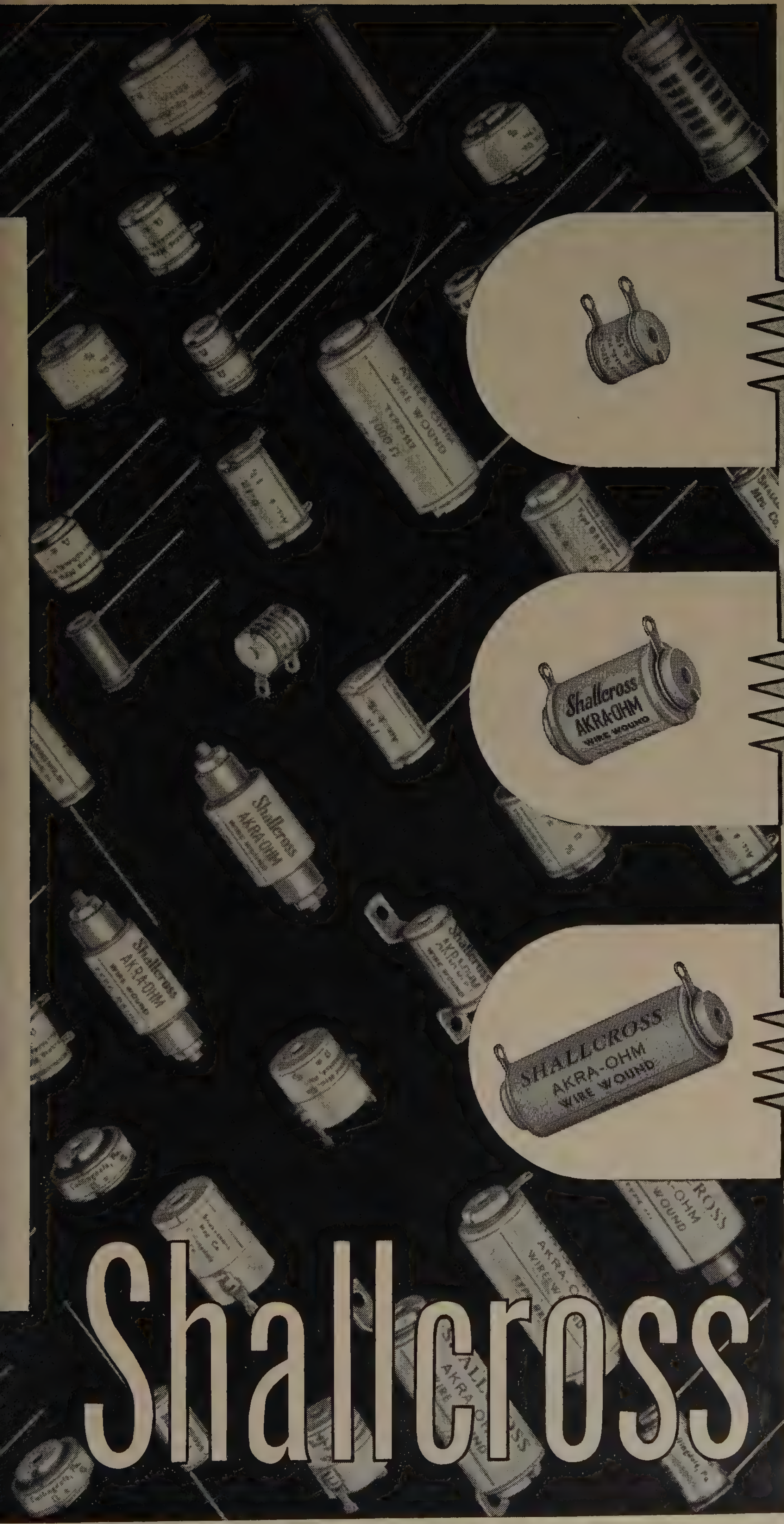
RESISTANCE PRODUCTS CO.
714 RACE ST. HARRISBURG, PENNA.

MEMBERSHIP

(Continued from page 101A)

Cohen, M., 3855 Nautilus Ave., Brooklyn 24, N. Y.
Cole, W. M., Jr., 908 N. Wayne St., Apt. 305, Arlington, Va.
Conlin, H. T., 1002 W. Market, Sandusky, Ohio
Cook, K. W., 5818 Access Rd., Dayton, Ohio
Corey, J. F., Box 1619, Balboa, Canal Zone
Cox, J. A., 1922 Winton Ave., Indianapolis 24, Ind.
Croom, W. J., 1426 West 40 St., Norfolk 8, Va.
Cutler, M. A., Bradley, Plainville, Conn.
Da Grosa, V., c/o Shallcross Manufacturing Co., Jackson & Pusey Aves., Collingdale, Pa.
Davies, R. W., 457-B Allenhurst Rd., Buffalo 23, N. Y.
Davis, C. J., 1634 S. 51 St., Cicero 50, Ill.
Dehm, R. E., 87 Englewood Ave., Buffalo 14, N. Y.
Dehmlow, L. L., 1318 S. Walnut Ave., Freeport, Ill.
Denyer, J. H. N., 736 Goulding St., Winnipeg, Man., Canada
Dew, C. D., c/o The Ohio Bell Telephone Co., 42 E. Gay St., Columbus 15, Ohio
Digenova, F., 12 Carobene Ct., Newburgh, N. Y.
Dill, J. M., 12215 Victoria St., Los Angeles, Calif.
Dinunno, J. J., Cedar Lane, Ednor, Mo.
Donovan, R. F., 136 State St., West Lafayette, Ind.
Douglas, J. H., 211 Buto, San Antonio, Tex.
Doyle, W. A., Box 3124, USAFIT, Wright-Patterson AFB, Dayton, Ohio
Drenchko, J. D., c/o Naval Air Development Center, Johnsville, Pa.
Drukaroff, I., 602 Seventh St., Lakewood, N. J.
Edwards, D. E., 1214 Ransom St., Sandusky, Ohio
Eisenbach, M. E., 16727—39 Ave., N. E., Seattle 55, Wash.
Elfman, R. S., 4706 N. Magnolia Ave., Chicago 40, Ill.
Elston, J. A., 271 Harbor St., Conneaut, Ohio
Euler, L. J., Jr., 5055 Franklin Ave., Los Angeles, Calif.
Eve, D. R., Box 72, AA & GM Branch, TAS, Fort Bliss, El Paso, Tex.
Farrell, R. L., I. A. Pak. Ltd., David Sassoon Bldg., McLeod Rd., Karachi 2, Pakistan
Fellhauer, H. E., 5841 El Monte Dr., Mission, Kans.
Fiebich, E. C., Heath Co., Benton Harbor, Mich.
Field, G. R., 211 Harding Ave., Collingswood 7, N. J.
Fitzsimmons, T. J., Round Hill Field Station, South Dartmouth, Mass.
Fleischer, A., 2912 Second St., S.E., Washington 20, D. C.
Flynn, J. E., 6625 McCallum St., Philadelphia, Pa.
Foley, T. J., County Line Rd., Hatboro, Pa.
Forte, S. S., Electrical Engineering Department, The University, Leeds 2, Yorks, England
Freedman, L. M., 10651½ Ashton Ave., Los Angeles 24, Calif.
Freyberg, J. A., 529 Pearl St., Sandusky, Ohio
Fried, G., 17 Normandy Dr., Bethpage, L. I., N. Y.
Fujiki, S., 1-73 Shin-Machi, Setagaya-Ku, Tokyo, Japan
Gagnon, R. L., 36 Ocean Ave., Salem, Mass.
Gaskell, R. J., 32 Barker Ave., Eatontown, N. J.
Gaskill, R. A., University of Michigan, Willow Run Research Center, Ypsilanti, Mich.
Gert, E. B., 8738 N. Peninsular, Portland 17, Ore.
Getty, J. N., Hq. 1125 FAG, Box 9531 ATIC Wright-Patterson AFB, Ohio
Gibbons, J., Price Waterhouse & Co., 56 Pine St. New York, N. Y.
Gillespie, L. H., 125 W. Weinert St., Seguin, Tex.
Goldfarb, J., 3521 Cedarbrook Rd., University Heights, Ohio
Granoff, N. H., 73-31—187 St., Flushing 66, L. I., N. Y.
Greene, R. L., 418 Morton St., Sharon, Pa.
Grossman, F. J., 39 Sickles St., New York 34, N. Y.
Habermann, C. L., 3309 Columbus Ct., Apt. 11, Columbus 9, Ohio

(Continued on page 106A)



NEW 3-WATT RESISTOR

Shallcross Type S 183-A is typical of the higher wattage ratings possible with silicone-enameled wire. Yet it measures only $\frac{9}{16}$" L. x ½" Diam. Maximum resistance is approximately 500K ohms.

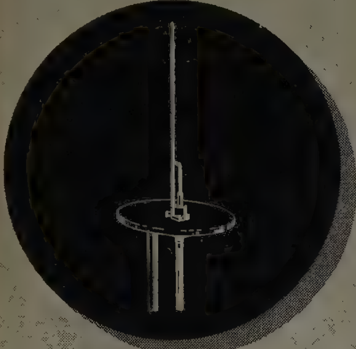
8-WATT PRECISION WIREWOUND RESISTOR

Wound with glass-insulated wire, silicone-impregnated, this Shallcross Type G 196-E resistor will dissipate 8 times the nominal wattage of the standard Type 196 resistor. Maximum resistance is 60K ohms. 1¼" L. by ¾" Diam.

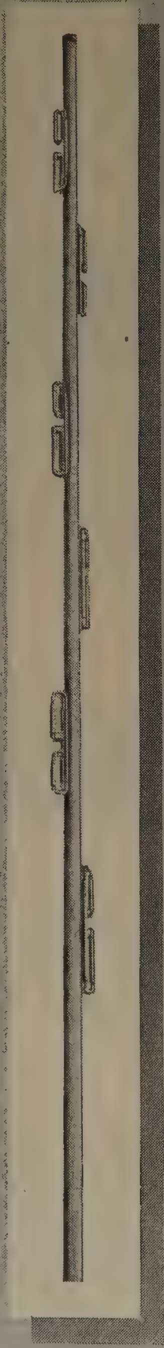
HIGHEST WATTAGE STANDARD RESISTOR

The BX 116-2E is the largest Shallcross resistor using standard resistance wire. Rated at 4-watts, the dimensions are only 3⅞" L. by ¾" Diameter. Maximum resistance is 20 megohms.

ANDREW offers a complete line of antennas for the 450-470 MC band!



The Isopole antenna, omnidirectional, rugged, inexpensive Type N input.



The High Gain antenna, omnidirectional, gain 6 DECIBELS PLUS.

The Corner Reflector antenna, 8db forward gain, broadband, horizontal or vertical polarization.

The Yagi antenna, two models with gains of 9.5 db and 12 db horizontal or vertical polarization.

Andrew CORPORATION ANTENNA SPECIALISTS
363 EAST 75TH STREET, CHICAGO 19

TRANSMISSION LINES FOR AM-FM-TV-MICROWAVE • ANTENNAS • DIRECTIONAL ANTENNA EQUIPMENT • ANTENNA TUNING UNITS • TOWER LIGHTING EQUIPMENT

MEMBERSHIP

(Continued from page 102A)

Hall, O. C., 1001 Wedgewood Rd., Baltimore 29, Md.
Hanks, W. R., 2365 Ardmore Ter., Winston-Salem, N. C.
Harkless, E. T., 435 Myrtle Ave., Scotch Plains, N. J.
Harms, A. D., Jr., 6806 Quincy St., Philadelphia, Pa.
Hauptli, J. T., 1111 Rice Ave., Bellwood, Ill.
Herman, H. F., 3223 Reynolds St., Dallas, Tex.
Hines, T. H., 1512 Ruth Ave., Cuyahoga Falls, Ohio
Hobbs, W. D., Jr., 11741 Stamy Rd., Whittier, Calif.
Hochman, D., 239C Haddon Hill Apts., Haddonfield, N. J.
Holmquist, J. A., 2108 Ottilia St., Utica, N. Y.
Holt, T., 443 West 71 St., Los Angeles 3, Calif.
Hom, S., 1178 Pacific Ave., San Francisco 11, Calif.
Horwitz, J. D., 3128 Diamond St., Philadelphia, Pa.
Houston, R. W., Far East Network Kyushu, Fenco, 8313 Army Unit, APO 3, c/o Postmaster, San Francisco, Calif.
Hurford, A. C., 96 Lakeside Dr., Levittown, Pa.
Husenita, J., 21 Palmer Rd., Yonkers, N. Y.
Jones, J. F., 4401 Hanover St., Dallas 5, Tex.
Jordan, E. I., 440 N. Broadway, Yonkers, N. Y.
Karney, T., Jr., 722 Third St., Box 253, Harvey, La.
Kazarian, R., c/o Ohio Crankshaft Co., 3800 Harvard Ave., Cleveland 1, Ohio
Kean, P. M., Sr., 3570 W. Granville Rd., Worthington, Ohio
Kelley, L. M., 109 Follen Rd., Lexington 73, Mass.
Kelly, R. J., 515—30 St., Union City, N. J.
Keough, D. D., 12224 Allengrove St., Philadelphia 24, Pa.
Kephart, E. T., 4309 Willis Ave., Merchantville 8, N. J.
Kimball, L. R., 2 Curve La., Levittown, L. I., N. Y.
King, L. G., Navy 961, Box 29, c/o FPO, San Francisco, Calif.
Klein, M. S., 3130 Brighton Sixth St., Brooklyn, N. Y.
Klucarich, S., 131 Beaver St., Fallston, New Brighton, Pa.
Knudsen, D. F., 347 Adelaide St., W., Toronto, Ont., Canada
Kravitz, J. S., 4630 N. Beacon St., Chicago 40, Ill.
Kumm, W. H., Air ARM Division, IDF, Westinghouse Electric Corp., Friendship International Airport, Baltimore, Md.
Kundler, H. H., 1 East 57 St., Rm. 701, New York, N. Y.
LaCoste, L. J. B., 3810 Speedway, Austin, Tex.
Ladouceur, C., 1193 Notre-Dame, Joliette, Que., Canada
Lahanes, C. J., 275 Massachusetts Ave., Cambridge, Mass.
Lamartin, F. H., Apt. 1-4, U. S. Naval Academy, Annapolis, Md.
Landow, I. S., 103 Neptune Ave., Brooklyn 35, N. Y.
Lane, J. W., 7420 Reeds La., Overland Park, Kans.
Larkin, W. E., 5001 Blanco St., El Paso, Tex.
LaRocca, J. J., 4255 N. Bernard St., Chicago 18, Ill.
Lawler, E. D., 268 Bowman Ave., Merion Station, Pa.
Laws, C. R., 511 Leffingwell, Kirkwood 22, Mo.
Lebid, J., 1088 Parkside Ave., Buffalo 14, N. Y.
Lehfeldt, H. J., Bldg. 92, Rm. 226 OL, National Bureau of Standards, Washington 25, D. C.
Lenz, H. G., 612 Home St., Winnipeg, Man., Canada
Lesko, N. J., NRL CBA, Chesapeake Beach, Md.
Linden, A. E., 6738 Wyncote Ave., Philadelphia 38, Pa.

(Continued on page 108A)

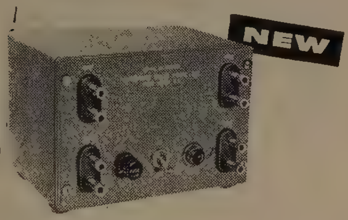
the pioneer is the leader

PANORAMIC

PANORAMIC IS THE PIONEER in the transformation of spectrum content into visual spectographic displays . . . known as the "Panoramic Method" by the entire electronic field.

PANORAMIC LEADS the industry in producing instruments unexcelled for every application requiring high speed spectrum or waveform analysis. Whatever your problem, a Panoramic Analyzer solves it quickly, accurately.

PANORAMIC leads again with



Signal Switcher—SW1

Designed to apply alternately test and standard signals to Panoramic Sonic Analyzers. Enables frequency comparisons to within a fraction of a cycle. Used with the G-2 Sonic Response Indicator, it facilitates rapid comparisons of the frequency responses of amplifiers, filters, transmission lines, etc.

Panalyzor—Model SB-12 Type T-100

Designed specifically for applications requiring extreme resolution or demanding measurement of levels of signals spaced very closely in frequency or widely divergent in amplitude.

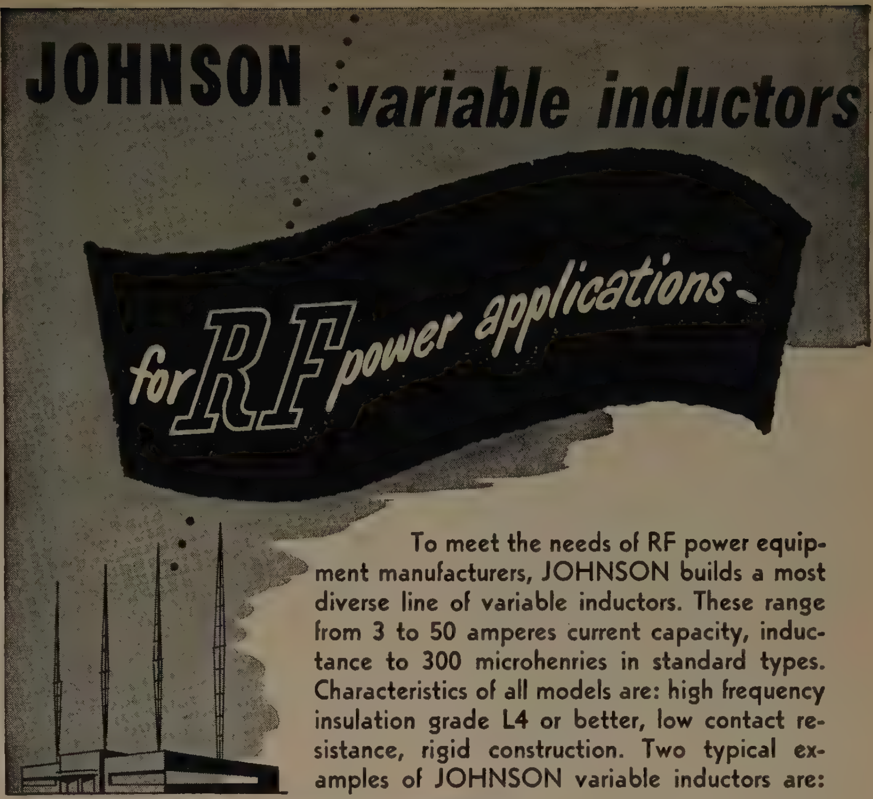
- Maximum Sweepwidth—100KC
- Maximum Resolution—10CPS
- Sweep Rates—30cps, 5 cps, 1 cps and 1 scan in 10 seconds

Inquiries invited on special Panoramic Spectrum Analysers

PANORAMIC
RADIO PRODUCTS, INC.

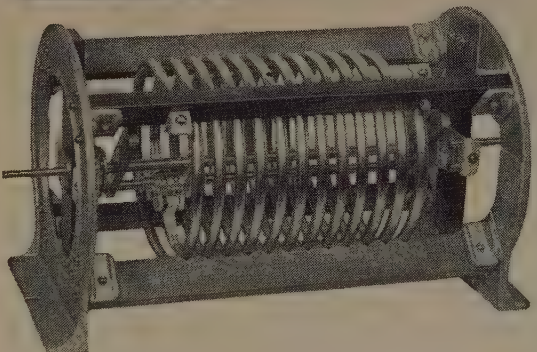
WRITE TODAY FOR COMPLETE SPECIFICATIONS AND PRICES

12 South Second Avenue, Mount Vernon, N.Y.
MOunt Vernon 4-3970



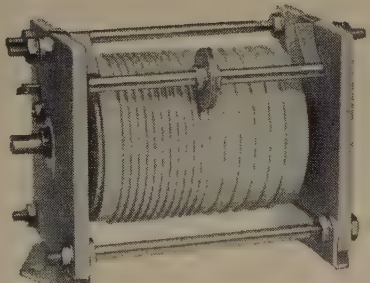
JOHNSON variable inductors for RF power applications

To meet the needs of RF power equipment manufacturers, JOHNSON builds a most diverse line of variable inductors. These range from 3 to 50 amperes current capacity, inductance to 300 microhenries in standard types. Characteristics of all models are: high frequency insulation grade L4 or better, low contact resistance, rigid construction. Two typical examples of JOHNSON variable inductors are:



224-2-1

Variable inductor for high power applications. Winding is 1/2" copper tubing rated to 50 amperes current. Inductance continuously variable to 16.5 microhenries. Spring loaded silver plated roller contact permits adjustment with full power applied. Insulators are glass bonded mica; cast aluminum end frames are slotted to minimize Eddy current losses. Overall dimensions: length 21 1/8", width 9", height 9". Available in eight standard models, maximum inductances 10 thru 110 microhenries. Variations from standard units such as special inductances, dual inductors for push-pull applications can be readily furnished in production quantities.



229-201

10 microhenry rotary inductor for 100 watt applications. Winding is #14 tinned copper wire with variable pitch for efficient extended frequency range. Beryllium copper tension springs maintain rolling contact. Overall size: length 4 1/2", width 2 1/2", height 3". Other inductors in the same series utilizing #12 and #16 tinned copper windings, maximum inductance 37 to 300 microhenries.

In addition to these illustrated types, the JOHNSON line includes many other variable and fixed inductors for low, medium and high power applications. Fixed inductors are available with single or multiple windings, fixed or variable coupling windings and with electrostatic shields.

For further information on all types of JOHNSON inductors, write for catalog 973—yours on request.

E. F. JOHNSON COMPANY

CAPACITORS, INDUCTORS, SOCKETS, INSULATORS, PLUGS, JACKS, DIALS, AND PILOT LIGHTS

204 SECOND AVENUE SOUTHWEST • WASECA, MINNESOTA

Try Remler for Service-Tested "Hard-to-Get" Components

Custom Components
Metal-plastic components designed and manufactured to order. Write for quotations specifying electrical and mechanical characteristics. Describe application. No obligation.

REMLER
TUBE SOCKETS
● STANDARD FOR 30 YEARS... THE BEST IN THE INDUSTRY

Heavy duty phenolic sockets with high current wiping action contacts . . . for industrial, transmitter and test applications. Rugged. Years of tube insertions and withdrawals do not impair contact effectiveness. Black phenolic, low loss phenolic or alkyd.

Remler Company Ltd. 2101 Bryant St. San Francisco 10, Calif.

Remler
Since 1918 PIONEERS IN ELECTRONICS AND PLASTICS

Fine WIRE For TRANSISTORS

In line with our specialization in wire for new applications, we produce wires of composition suitable for the manufacture of Transistors; including GALLIUM GOLD and ANTIMONY GOLD. These alloys have been made to fill a specific need arising from new developments in this field.
Other wires we make regularly for similar application are PHOSPHOR BRONZE, bare or electroplated, and PLATINUM Alloys produced to meet rigid specifications of tensile strength, size and straightness.

SINCE 1901

Write for Latest List of Products

SIGMUND COHN CORP. 121 So Columbus Avenue • Mount Vernon, N.Y.

MEMBERSHIP

(Continued from page 106A)

Linker, C. L., 3628 Southwestern Blvd., Dallas 5, Tex.
Lofths, W. E., 4454 N. Racine Ave., Chicago 40, Ill.
Lolass, A., Jr., 2493 St. Pierre Ave., Altadena, Calif.
Losher, M. I., 10240—67 Dr., Forest Hills, L. I., N. Y.
Lubin, E., 2187A N. John Russell, Elkins Park 17, Pa.
Luty, R. C., Jr., Apt. 0-2, 531 Kings Highway, Moorestown, N. J.
Manor, N. D., 403 W. Main St., Xenia, Ohio
Marie, C. G., 88 York Rd., Lynn, Mass.
Mark, W. R., 440 E. Sharon Ave., Glendale, Ohio
Marsland, J. W., c/o Marsland Engineering Co., 154 Victoria St., S., Kitchener, Ont., Canada
Martin, J. A., Jr., 1904 Fairview St., Willow Grove, Pa.
May, J. C., 306 Kennebec St., Washington, D. C.
McCoskrie, D., 623 Westview St., Philadelphia, Pa
McFarland, D. J., 1055 Water St., Eau Gallie, Fla
McFarlane, H. M., Texas Forest Service, Lufkin, Tex.
McGregor, G. L., Lincoln Highway West, R.F.D. 3, Fort Wayne, Ind.
McGuire, T. B., Apt. 201, 210 Lynnwood St, Alexandria, Va.
McGuire, W., 711 S. Front St., Hamilton, Ohio
McKnight, V. J., R.F.D. 3, Box N 177, New Bern, N. C.
Mech, H. D., 54 W. Main St., Corfu, N. Y.
Memzies, R. W., 64 Terrace Rd., Medford 55, Mass
Mennen, H., 3303 Harlem Rd., Buffalo 25, N. Y.
Mikaelian, M., 318 Grand Ave., Dayton 5, Ohio
Miller, A. M., 119 N. Saratoga St., Olney, Ill.
Miller, C. M., 103 Linda Lou Dr., San Antonio 10, Tex.
Mitchell, J. L., Massachusetts Institute of Technology, Digital
Computer Laboratory, 68 Albany St., Cambridge, Mass.
Monari, A. J., T. C. Wheaton Co., Millville, N. J.
Monsees, F. G., 221-43—91 Ave., Queens Village, L. I., N. Y.
Moses, N. J., 144 Ringdahl Ct., Rome, N. Y.
Murphy, E. F., 216 W. Rankin St., Flint, Mich.
Nicholson, V., 1439 Lardner St., Philadelphia 24, Pa.
Nofrey, L. C., 3916 Carrington St., Oakland 1, Calif.
O'Brien, J. F., c/o Plastoid Corp., 5 Old Rd., Hamburg, N. J.
O'Donnell, J. J., 56 Twin Lane N. Wantagh, L. I., N. Y.
Oister, G. K., 571 Lincoln Ave., Pottstown, Pa
Olsen, T. W., 9225 Convent Ave., Philadelphia 14, Pa.
Oslake, J. J., 801 W. Ferry St., Buffalo 22, N. Y.
Ozaki, G. K., 2122 Eby Ave., Fort Wayne, Ind.
Palmer, J. C., 40 Trumbull St., Xenia, Ohio
Parker, W. E., 54 Cottage Pl., Long Branch, N. J
Parris, W. J., 11-A Brookwood Garden Apts., Burlington, N. C.
Patrick, D. J., 1804 Sixth Ave., Dodge City, Kans
Pawlowski, F. L., 8137 N. Keating, Skokie, Ill.
Pearson, L., 527 Jeanne-D'Arc, Montreal 4, Que., Canada
Peters, J. C., Box 3431, USAFIT, Wright-Patterson AFB, Dayton, Ohio
Peterson, D. G., 695 E. First Pl., Mesa, Ariz.
Petitto, S. D., c/o Mrs. Richards, 4045 N. Greenview Ave., Chicago 13, Ill.
Pettersen, E. S., 673—85 St., Brooklyn 9, N. Y.
Phillips, A. H., 4453 Pelham, Dearborn, Mich.
Pidgeon, R. E., Jr., 206 Gelpi Dr., Lake Charles, La
Polhemus, G. C., 431 Conshohocken State Rd, Cynwyd, Pa.
Porter, F. A., Page Engineers, APO 677, c/o Postmaster, New York, N. Y.

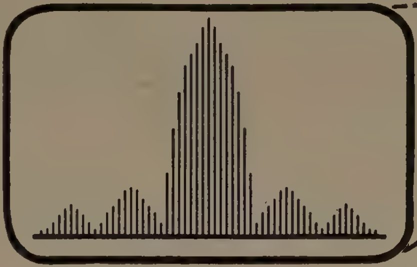
(Continued on page 110A)

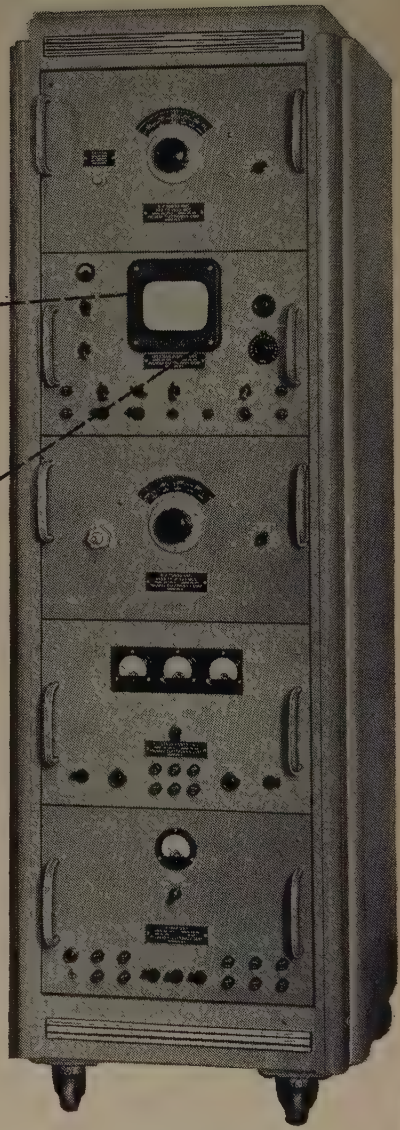
The FIRST
and still the only
ALL-BAND DIRECT READING

SPECTRUM ANALYZER

10 MCS TO 21,000 MCS

Polarad's Model LSA Spectrum Analyzer is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an r.f. signal.





- Continuous tuning.
- One tuning control.
- Resolution is 5KC when dispersion is 5MC per inch per sec.
- 250 KC to 25 MCS display at all frequencies.
- Tuning dial frequency accuracy 1%.
- No Klystron modes to set.
- Broadband attenuators supplied with equipment from 1 to 12 KMC.
- Frequency marker for measuring frequency differences 0-25 MCS.
- Only four tuning units required to cover entire range.
- Microwave components use latest design noncontacting shorts for long mechanical life.
- Maximum frequency coverage per dollar invested.
- 5 inch CRT display.

Where Used:

Model LSA Spectrum Analyzer is a laboratory instrument used to provide a visual indication of the frequency of distribution of energy in an r.f. signal in the range 10 to 21,000 MCS.

Other uses are:

1. Observe and measure sidebands associated with amplitude and frequency modulated signals.
2. Determine the presence and accurately measure the frequency of radio and/or radar signals.
3. Check the spectrum of magnetron oscillators.
4. Measures noise spectra.
5. Check and observe tracking of r.f. components of a radar system.
6. Check two r.f. signals differing by a small frequency separation.

THE INSTRUMENT CONSISTS OF THE FOLLOWING UNITS:

Model LTU—1 RF Tuning Unit—10 to 1000 MCS.
Model LTU—2 RF Tuning Unit—940 to 4500 MCS.
Model LTU—3 RF Tuning Unit—4460 to 16,520 MCS.
Model LTU—4 RF Tuning Unit—15,000 to 21,000 MCS.
Model LDU—1 Spectrum Display Unit.
Model LPU—1 Power Unit.
Model LKU—1 Klystron Power Unit.

Write for Complete Details

Polarad
Electronics Corporation

100 METROPOLITAN AVE.
BROOKLYN 11, N. Y.
Export Dept.: 13 East 40 Street, New York 16, N. Y.
Cable Address: "ARLAB"

Perfection BY SCREEN PRINTING

FROM BLUE-PRINT TO FINISHED PRODUCTS.

- COMPLETE ART AND PHOTOGRAPHY DEPARTMENT
- FINISHING DEPT. COMPRISES METAL PREPARATION & SPRAYING
- RADIUM COMPOUND & LUMINESCENT MATERIAL APPLICATION
- COMPLY TO GOVERNMENT SPECS.

AIRCRAFT DIALS RADIO & TELEVISION DIALS. INSTRUMENT PANELS & SCHEMATICS TERMINAL BOARDS & CHASSIS

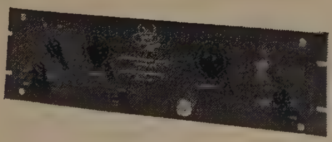
SERVING THE AIRCRAFT & ELECTRONIC INDUSTRIES.

THE MOST ADVANCED METHOD OF SCREEN PRINTING ON WRINKLE & ENAMEL.

Wrinkay REG. U.S. PAT. OFF.

PHOTO CHEMICAL PRODUCTS, INC.
479 WALTON AVENUE
NEW YORK 51, N.Y.

NEW! Tubeless Regulated Dual DC Supply for Transistor Application



Model 110
Price $149.50

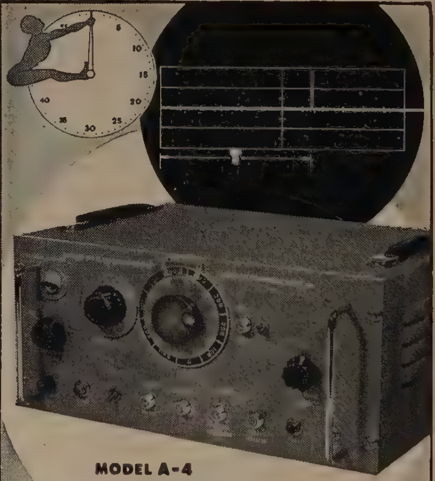
Features

- √ No Tubes-Long Life
- √ Negligible Warm-up Time
- √ Dual Output-Positive or Negative
- √ Continuously Variable Outputs
- √ Output #1—Triple Range at 60 ma 0-1.0, 10, 100 v.
- √ Output #2 0-100 v at 60 ma
- √ DC Impedance less than 100 ohms
- √ Line Regulated 95-125 v
- √ Ripple Less Than 0.01%
- √ Moderately Priced

Order Now for quick delivery or write for Bulletin B I.

ERA

Electronic Research Associates
Dept. I 1, Box 29, Caldwell, N.J.



MODEL A-4
TIME DELAY GENERATOR

- A precision device for the generation of accurate and variable time intervals from .00001 to 10 seconds.

Also available:
Model A-2—.8 to 100,000 μs.

Write for complete data:
Our bulletins I-A-4 and I-A-2

Rutherford
ELECTRONICS CO.
3707 S. ROBERTSON BLVD., CULVER CITY, CALIF.

MEMBERSHIP

(Continued from page 108A)

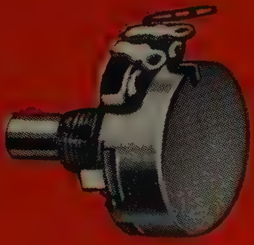
Powell, G. M., 74 Rebecca St., Shinnston, W. Va.
Powers, W. J., 25 Abbott Pl., Fall River, Mass.
Rector, D. A., 30 S. Old Glebe Rd., Arlington, Va.
Reed, G. W., 319 Highland Rd., Ithaca, N. Y.
Reynolds, R. N., Jr., Box 162, Stony Brook, L. I., N. Y.
Richard, J. D., Jr., 531 S. Barrancas Ave., Warrington, Fla.
Riley, J. H., 3105 Amherst St., Dallas, Tex.
Rixse, J. A., 150 S. Virginia Ave., Falls Church, Va.
Robins, H. M., 700 Bittersweet Pl., Chicago 13, Ill.
Rodda, E. N., 5838½ West 87 St., Los Angeles 45, Calif.
Rodgers, J. L., 5707 Tilden Ave., Apt. 6, Van Nuys, Calif.
Rogers, T. E., 1102 Southland Life Bldg. Annex, Dallas 1, Tex.
Rolfe, R. G., 2105 Belvedere Blvd., Silver Spring, Md.
Rousey, W. A., 9444 Danby Ave., South Whittier, Calif.
Ruttenberg, S., 561 Broadway, New York 12, N. Y.
Saari, V. R., 9 Irvington Pl., Clifton, N. J.
Sautner, J., 228 Burlington Ave., Paterson 2, N. J.
Savage, L. A., 426 E. Genesee, Flint, Mich.
Schafer, N. B., 1208 Madison Ave., Austin 5, Tex.
Schneeberger, R. F., 315-D Langfield Dr., Buffalo 15, N. Y.
Scott, S. D., Box 3068, USAFIT MCLI, Wright-Patterson AFB, Dayton, Ohio
Scott, W. W., R.C.A.F. Station Clinton, Clinton, Ont., Canada
Seals, M. L., 712 Strathcona St., Winnipeg, Man., Canada
Seligman, J. M., 3047 Kensington Ave., Philadelphia 34, Pa.
Selover, E. E., Box 3420, USAFIT, Wright-Patterson AFB, Dayton, Ohio
Severance, F. D., 714 W. Front, Burlington, N. C.
Sheehan, J. F., 74 Victory Dr., Niagara Falls, N. Y.
Sheldon, M., 64 West 91 St., New York 24, N. Y.
Shelford, L. L., R.F.D. 1, Middleport, N. Y.
Shenk, J. J., R.F.D. 1, Northumberland, Pa.
Siegel, H. A., 527 Peck Ave., San Antonio 10, Tex.
Silver, N., 84 Bracewood La., Stamford, Conn.
Sindelar, F. J., Kimball Rd., Poughkeepsie, N. Y.
Sippach, F. W., 429 Wyoming Ave., Maplewood, N. J.
Slocum, G. V., Box 353, Shaw AFB, Sumter, S. C.
Smith, C. C., Sunset Crossing, Littleton, Mass.
Smith, L., 26-16 Union St., Flushing 54, L. I., N. Y.
Spencer, P. L., 85 Adena Rd., West Newton 65, Mass.
Spencer, R. W., 411 W. Mt. Airy Ave., Philadelphia 19, Pa.
Spiller, M. E., Jr., 21 Bennett Pl., Leominster, Mass.
Stanley, H. T., 62 Throckmorton Ave., Red Bank, N. J.
Staples, R. L., 28 S. Wood, Emporium, Pa.
Staunton, J. J. J, 310 Wesley Ave., Oak Park, Ill.
Stone, I. C., 128 Greenfield Rd., Mattapan 26, Mass.
Studwell, A. E., 77 Howard Ave., Rochelle Park, N. J.
Taggart, C. E., 101 Carpenter Ave., Mt. Kisco, N. Y.
Tanielian, G., 3262 Overland, Los Angeles, Calif.
Taylor, A. D., 324 S. Sultana Ave., Upland, Calif.
Terrell, D. S., R.C.A.F. Station, Clinton, Ont., Canada
Thomas, C. P., Box 3288, USAFIT, Wright-Patterson AFB, Dayton, Ohio
Thomas, O. D., Jr., c/o Mrs. Lura Mae Cooper, 2331 Cincinnati Ave., Apt. 2, San Antonio 1, Tex.
Tidd, T. J., 20 Briarcliffe Rd., Glenolden, Pa.
Tiffin, C. M., 25 Branch Brook Pl., Newark 4, N. J.

(Continued on page 114A)

COMPLETE MILITARY LINE

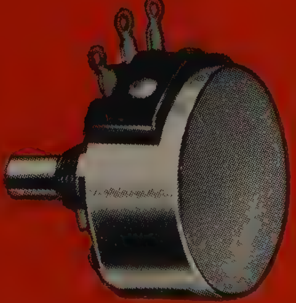
Immediate delivery from stock on 189 types including JAN-R-94 and JAN-R-19 types of variable resistors.

NEW 38-PAGE ILLUSTRATED CATALOG—
Describes Electrical and Mechanical characteristics, Special Features and Constructions of a complete line of variable resistors for military and civilian use. Includes dimensional drawings of each resistor. *Write today for your copy.*

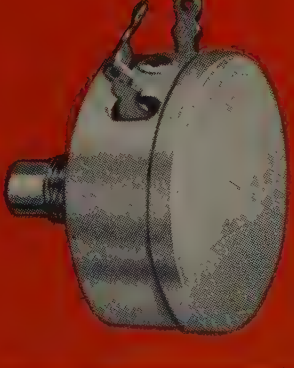


TYPE 45, (JAN-R-94, Type RV2)
1/4 watt, 15/16" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

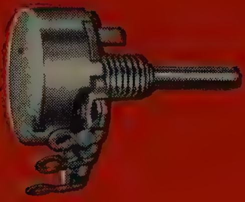
TYPE 35, (JAN-R-94, Type RV3)
1/2 watt, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.



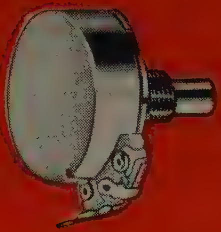
TYPE 252, (JAN-R-19, Type RA20)
2 watt, 1 17/64" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



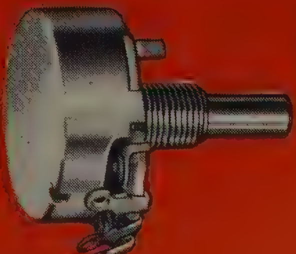
TYPE 25, (JAN-R-19, Type RA30)
(May also be used as Type RA25)
4 watt, 1 17/32" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



TYPE 65, (Miniaturized)
1/2 watt 70°C, 3/4" diameter miniaturized variable composition resistor.



TYPE 90
1 watt 70°C, 15/16" diameter variable composition resistor. Attached switch can be supplied. Also available in concentric shaft tandem construction.



TYPE 95, (JAN-R-94, Type RV4)
2 watt 70°C, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

UNPRECEDENTED PERFORMANCE CHARACTERISTICS

Specially designed for military communications equipment subject to extreme temperature and humidity ranges. -55°C to +150°C...aridity to saturation.

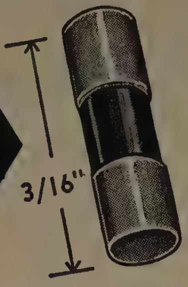
CTS

CHICAGO TELEPHONE SUPPLY
Corporation

ecision Mass Production of Variable Resistors

MICROWAVE RESISTORS
TELEWAVE TYPE R

SMALLEST RESISTOR AVAILABLE
(Ideal for Miniaturization)



TYPICAL APPLICATIONS
- Power measurement at any frequency
- Matched terminations for waveguides or coaxial lines
- Resistive power pickup loops
- RF pads or attenuators
- Dummy loads
- Temperature measurements
- Impedance matching

TYPE R RESISTORS employ noble metal film deposits on specially selected heat resistant glass.
FILM THICKNESS offers negligible skin effect, at microwave frequencies.
POWER CAPACITY of 1/4 watt provides high power handling ability.
PHYSICAL STRUCTURE is ideally suited to impedance matching in standard coaxial line and waveguides.
FINISH. Coated with a special silicone varnish to protect the film.

SPECIFICATIONS
Resistance: 50 ohms standard, other values on request.
Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 25°C
Size: 1/16 inch diam. x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 — 1/16 inch
Type R-093 — 3/32 inch
Temperature Coefficient: approx. 0.0019 ohms/ohm/°C.
Power Sensitivity: Approx. 10 ohms/watt

AVAILABLE FOR IMMEDIATE DELIVERY

TELEWAVE LABORATORIES, INC.
100 Metropolitan Ave. • Brooklyn 11, New York

SQUARE PULSE GENERATORS for the MILLIMICROSECOND to MICROSECOND RANGE

Model 100
Square Pulse Generator
PRICE: $395.00 F.O.B. New York

For Nuclear Pulse Work, Radar, TV, Wide Band Amplifiers, and in the design, calibration and servicing of fast electronic systems:

NOW—A new Square Pulse Generator with a rise time of one millimicrosecond (10^{-9} seconds) and a pulse width which can be varied from one millimicrosecond to several microseconds provides the ideal test instrument for fast electronic circuits. Both positive and negative pulses of a 100 volts maximum amplitude, into low impedance (such as 50 ohm cable) are generated; the pulse amplitude can be varied from 100 volts to .006 volts in 1 decibel steps by means of selector switches on the front panel. One, two, or more pulse outputs, each of which can be individually attenuated and delayed are available in various models.

For further details, write for bulletin P-1A or contact our Engineering Division.

ELECTRICAL AND PHYSICAL INSTRUMENT CORPORATION
Sales and Business Office
25 West 43 Street
New York 36, N.Y.
Telephone: LOngacre 4-8510
Engineering Division
42-19 27th Street
Long Island City, N.Y.
Telephone: STillwell 4-6389

Membership

(Continued from page 110A)

Tou, J., 163 W. Abbotsford Ave., Philadelphia 44, Pa.
Turner, H. C., Box 79-B, R.F.D. 9, San Antonio 7, Tex.
Uphoff, R. D., 18 Reid St., West End, N. J.
Van Valkenburg, E. S., 808 Cornell Rd., Ypsilanti, Mich.
Verrecchia, T. A., 540 Charles St., Providence 4, R. I.
Vilbig, J. L., Jr., 3887 Van Ness, Dallas, Tex.
Vogt, W. M., Jr., Box 756, Denham Springs, La.
Walden, A., 824 Lovett Way, Pittsburgh 12, Pa.
Walker, T. J., 2522 Collins Rd., Pittsburgh 35, Pa.
Walkling, R. W., 8 School House La., Broomall, Pa.
Warren, R. E., 525 Edgeworth St., Middlesex, N. J.
Waters, W. M., 6116 MacBeth Dr., Baltimore 12, Md.
Watts, W. W., RCA Victor Division, Camden, N. J.
Weaver, M. W., 71 Matilda Ter., Long Branch, N. J.
Webb, W. C., Jr., 332 Morton Ave., Dayton 10, Ohio
Weiland, G. H., 77-43—166 St., Flushing, L. I., N. Y.
Weir, D. B., R.F.D. 5, Willson Rd., Welland, Ont., Canada
Wendlandt, C. W., 3441 Wellington Rd., Fort Worth, Tex.
Wetherbee, J. K., 1807 Kings Ct., Columbus 12, Ohio
Wilber, B. E., Rye Beach R.F.D. 1, Huron, Ohio
Wilgus, D. S., 831 S. W. Sixth Ave., Portland 4, Ore.
Williams, G. W., Jr., 213-08 Northern Blvd., Bayside, L. I., N. Y.
Williams, G. P., 2755 S. W. 58 Ave., Miami 44, Fla.
Wilson, J. L., Box 50, Rivonia, Johannesburg, Transvaal, South Africa
Wisnowski, W. C., 3412 N. Avers, Chicago, Ill.
Woldow, A. F., 311 Cooper St., Camden 2, N. J.
Woodman, A. J., 5149 N. Wolcott, Chicago 26, Ill.
Wulkan, A. A., Box 1, Kiryat Motzkin, Haifa, Israel
Young, R. L., Jr., 37-B Cedar Dr., Baltimore 20, Md.
Zahn, E., 25 Carroll Ct., Bridgeport, Conn.
Zarbertski, E. I., 326 E. Union St., Nanticoke, Pa.
Zaremba, C. J., 99 Charles St., Floral Park, L. I., N. Y.
Zitovksy, S. A., 378 Boulevard, East Paterson, N. J.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 55A)

G.E. to Double Germanium Diode Production

The General Electric Co., Electronic Park, Syracuse, N. Y., will double its production of germanium diodes this year, to meet the rising demand of television manufacturers.

Their principal use is in home television receivers, where they perform as video detectors, according to James H. Sweeney, germanium products sales manager.

Each of the 6.5 million TV sets expected to be built by the industry next year will incorporate as many as three of the tiny devices.

(Continued on page 116A)

CLIMATE-PROOF PACKAGING

CARGO

Here's a quick solution to MILITARY PACKAGING

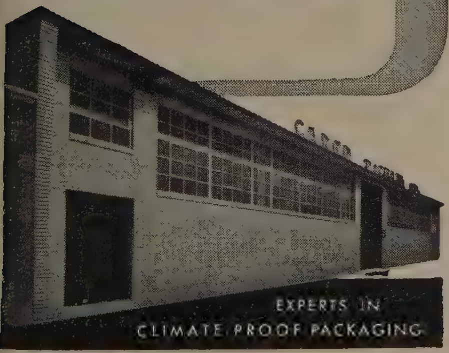
CARGO PACKERS CLIMATE-PROOF PACKAGING

Meets all Specifications for Signal Corps, Navy and Air Force Shipments of Electronic Equipment with Facilities that include—

- SPECIAL PACKAGING EQUIPMENT
- EXPERTS IN MILITARY SPECIFICATIONS
- ECONOMICAL ASSEMBLY LINE METHODS
- FULL COMPLIANCE IN EVERY DETAIL
- COMPETENT CONSULTING SERVICE

NEW ILLUSTRATED BROCHURE explains in detail how Cargo Packers can economically handle all details of your military packaging problems. You save valuable plant space, costly equipment and the need for experienced specification packaging experts. Find out now, how Cargo Packers production line methods save you time, money, endless detail work, and costly errors. Request your copy, now!

CARGO PACKERS
INCORPORATED
73 RUTLEDGE STREET
BROOKLYN 11, NEW YORK



triple threat

Changing temperatures, vibrations, and accelerations affect the operation of all instruments. In spite of these variables, our products produce the right answers because they are properly designed.

- AIRCRAFT INSTRUMENTS AND CONTROLS
- OPTICAL PARTS AND DEVICES
- MINIATURE AC MOTORS
- RADIO COMMUNICATIONS AND NAVIGATION EQUIPMENT

Current production is largely destined for our defense forces; but our research facilities, our skills and talents, are available to scientists seeking solutions to instrumentation and control problems.

kollsman INSTRUMENT CORP.

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA • SUBSIDIARY OF *Standard* COIL PRODUCTS CO., INC.

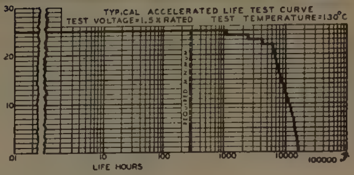
Further Proof of

Getting to the bottom of things

. . . is most clearly demonstrated by what we are doing every hour of every day — year in and year out — to make a finer fixed CAPACITOR.

One of the many things you as users are interested in is the "LIFE OF THE CAPACITOR" under a multitude of operating conditions. We in the FAST organization have spared no expense to give you honest-to-goodness answers on this important factor in providing quality capacitors.

What follows is a summary of what we are doing to give you just that . . .



I: RESEARCH and DEVELOPMENT TESTS

AC and DC tests at various temperatures and voltages.

1—Investigation of Impregnants: (a) New impregnants AC—synthetic and natural oils. DC—oils, resins and waxes. (b) Studies of impurities and additives.

2—Investigation of electrode separators and electrode materials: (a) Modified kraft papers—low PF varieties and sundry densities. (b) Films—regenerated cellulose, polystyrene, teflon, "Mylar"*, Etc.

3—Number of groups tested: AC; over 800 involving more than 8000 units. DC; over 3300 involving more than 70,000 units.

4—Duration of tests: AC; many have been continuously under test for over 6 years. DC; many have been continuously under test for over 10 years.

5—Voltage range of tests: AC; 70 to 2400 volts at 60 and 400 cycles. DC; 140 to 44,000 volts.

6—Temperature range of tests: AC; Room to 130°C. DC; —55°C to +150°C.

II: PRODUCTION TESTS

A. Alternating Current

1—Heat runs on production lots—ultimate surface temperature rise.

2—Ultimate life hours of current production (periodic tests run).

B. Direct Current

1—Civilian Production: (a) ultimate life hours of capacitors taken from current production. (These test runs comprise over 1600 groups involving more than 16,000 units)

(b) Ultimate life hours of capacitors after being stored in cartons from 1 to 24 months under normal variations in humidity and temperature. (These test runs comprise over 230 groups involving more than 2300 units)

2—Military Production: (a) Test to applicable specifications (Jan. C-25; Jan. C-91; U. S. Army 71-1667; Etc.)

(b) These test runs comprise over 3300 groups involving more than 19,000 capacitors.

Please note Carefully: at least 80% of the 115,300 capacitors included in the above tests were tested to destruction at voltages from 1½ to 4 times rated and at maximum rated—or in excess of—operating temperatures. Many outside this group have not failed to date. Importantly too, this is a continuous policy of the company in sustaining our testing program throughout every day —year after year.

So with pardonable pride may we suggest QUALITY CAPACITORS is more than a "catch-phrase" as applied to the FAST organization . . . and another link in the chain of GETTING TO THE BOTTOM OF THINGS?

* Du Pont trade-mark for Polyester Film

JOHN E. FAST & CO.

Capacitor Specialists For
Over A Third of A Century
3177 North Pulaski Road, Chicago 41, Ill.
"WHEN YOU THINK OF CAPACITORS . . . THINK FAST"

The new S.S. WHITE 80X
HIGH VOLTAGE RESISTOR

(½ Actual Size)

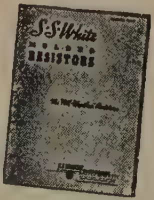
4 watts • 100 to 100,000 megohms

Developed for use as potential dividers in high voltage electrostatic generators, S.S.White 80X Resistors have many characteristics—particularly negative temperature and voltage coefficients—which make them suitable for other high voltage applications.

They are constructed of a mixture of conducting material and binder made by a process which assures adequate mechanical strength and durability. This material is non-hygroscopic and, therefore, moisture-resistant. The resistors are also coated with General Electric Dri-film which further protects them against humidity and also stabilizes the resistors.

WRITE FOR BULLETIN 4906

It gives complete information on S.S.White resistors. A free copy and price list will be sent on request.



THE S.S.White INDUSTRIAL DIVISION
DENTAL MFG. CO.
Dept. GR 10 East 40th St.
NEW YORK 16, N. Y.
WESTERN DISTRICT OFFICE: Times Building, Long Beach, Calif.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 114A)

Sweeney said the recent allocation by the Federal Communications Commission of 70 new TV channels in the ultra-high frequencies is largely responsible for the production increase. Tuners and converters to permit reception of the uhf channels each require one or two germanium diodes, he explained.

Nearly every TV set now manufactured for receiving very-high-frequency stations (channels 2 through 13) also incorporates one of these devices.

Power Supply

A new and highly precise high-power direct-current source, designed for digital and analogue computers, business machines and other complex electronic devices, has recently been developed by **Inet, Inc.**, 8655 S. Main St., Los Angeles 3, Calif.

This magnetic amplifier-selenium rectifier dc power supply, provides dynamic regulation of better than 0.2 per cent with wide load and alternating current line changes. Steady state regulation proved to be less than 0.15 per cent from no load to full load, with ±10 per cent ac line voltage. RMS ripple can be filtered as low as 0.01 per cent; with 0.5 per cent as standard.

Inet's precision power supply is said to require about half the space of many types of equipment with comparable performance, and is housed in a single compact cabinet, or can be built with dimensions to customer's specifications.

The selenium rectifier-magnetic amplifier design eliminates thyratrons or ignitions. Thus the equipment is designed to require the minimum of maintenance and parts replacement. Because of its high efficiency (approximately 75 per cent), the unit has sufficiently cool operation to reduce refrigeration requirements in office-installed computers.

(Continued on page 118A)

need relays?

Potter & Brumfield is your **BEST SOURCE for CUSTOM-BUILT RELAYS**

here's why!

Design

Fast, accurate development of relays for every electrical and electronic application to meet the most exacting military or industrial specifications.

Engineering

Extensive research, laboratory and model shop facilities available to help solve design engineers' most complex relay problems.

Manufacturing

Three large, fully equipped plants geared to meet today's rigid production requirements . . . single shift capacity of 10,000 relays per day!

- Samples, Recommendations and Quotations on Request.
- P & B Sales Engineers in Principal U. S. and Canadian Cities.
- Write for Master Catalog Showing Full Line of Basic Structures.
- Standard Relays Available At Your Electronic Parts Distributor.

Potter & Brumfield
PRINCETON, INDIANA
Export: 13 E. 40th St., N. Y., N. Y.

ENGINEERS...TECHNICIANS!..*here is your*

New! B&W Dip Meter

Model 600

NEW LOW PRICE: $39.75 NET

VERSATILITY, COMPACTNESS, QUALITY

Few instruments will prove so handy in so many ways as this versatile B&W Model 600 Dip Meter! Ideal for lab, production, service or ham shack use, it provides a quick, accurate means for measuring resonant circuit frequencies, spurious emissions and many other tuned circuit characteristics. Shaped for easy use in today's compact electronic assemblies, highly sensitive and accurately calibrated, it incorporates many features previously found only in higher-priced instruments. You'll find dozens of uses for it as . . .

A Grid Dip Oscillator for determining resonant frequencies of tank circuits, antennas, feed line systems, and parasitic circuits; aligning filters and traps; peaking coils, neutralizing and tuning transmitters before power is applied.

An Absorption Wave Meter for accurately identifying the frequency of radiated power from various transmitter stages; locating spurious emissions causing troublesome TV and radio interference, and many similar uses.

An Auxiliary Signal Generator providing a signal for tracing purposes and for preliminary alignment of receivers, converters, and I-F stages.

An R-F Signal Monitor for audible observation of hum, audio quality, and other audible characteristics of radiated power.

For Capacity, Inductance, and "Q" measurements in conjunction with other components of known value.

TECHNICAL FEATURES

- ✓ Covers 1.75 to 260 mc. in 5 bands.
- ✓ Adjustable sensitivity control.
- ✓ Size 3" x 3" x 7". Weight 2 lbs.
- ✓ Handy wedge-shape for easy access in hard-to-get-at places.
- ✓ Monitoring jack and B+ OFF switch.
- ✓ Rust-proofed chassis, aluminum case.
- ✓ Built-in power supply for 110 volts A.C.

Sold by leading distributors throughout U. S. A. and Canada
Data bulletin sent on request.

BARKER & WILLIAMSON, INC.
237 Fairfield Avenue Upper Darby, Penna.

control motors . . .

FORD

for extremely low inertia and high frequency response

HIGH VOLTAGE MOTORS

60 Cycle, 1½-5-10 watt models
Designed specifically for electronic systems—operate directly in the plate circuit of a vacuum tube amplifier.

LOW VOLTAGE MOTORS

60 and 400 Cycle, 2½-5-10 watt models
Recommended for normal two-phase applications.

advantages

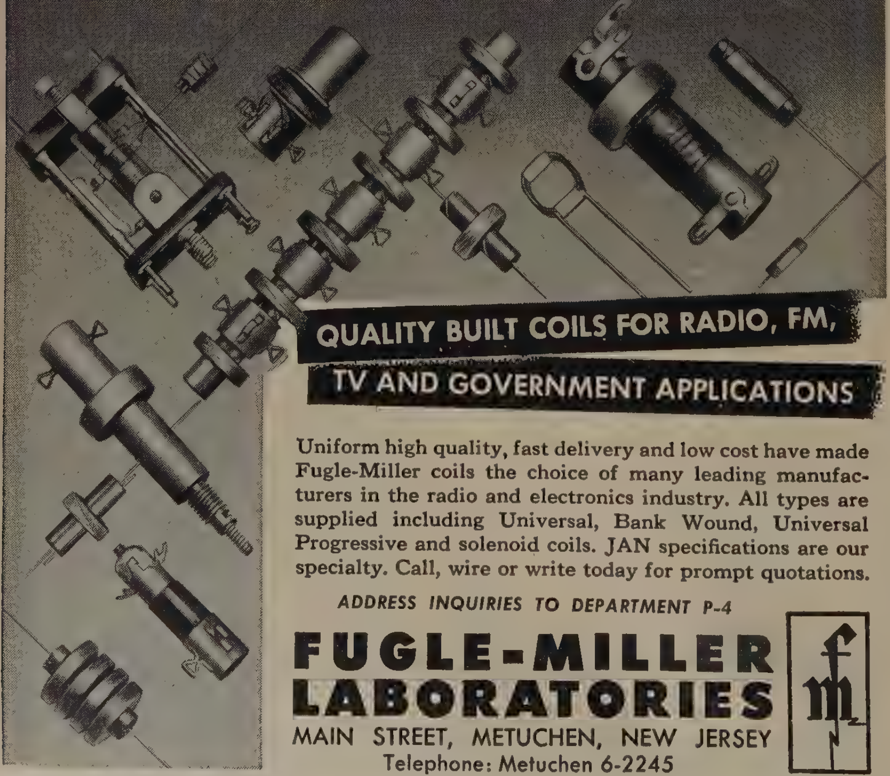
- Linear torque—voltage characteristics
- Linear torque—speed characteristics
- Withstand continuous stalling
- High torque efficiency
- Flexibility of mounting

10 Watt

Rotor Inertia 0.23 oz-in.^{2}
Weight 4.3 lbs.

Write for Descriptive Brochure about all Ford Control Motors.

FORD INSTRUMENT COMPANY
Division of The Sperry Corporation
31-10 Thomson Avenue, Long Island City 1, N. Y.



COILS *to exact specification for every requirement*

QUALITY BUILT COILS FOR RADIO, FM, TV AND GOVERNMENT APPLICATIONS

Uniform high quality, fast delivery and low cost have made Fugle-Miller coils the choice of many leading manufacturers in the radio and electronics industry. All types are supplied including Universal, Bank Wound, Universal Progressive and solenoid coils. JAN specifications are our specialty. Call, wire or write today for prompt quotations.

ADDRESS INQUIRIES TO DEPARTMENT P-4

FUGLE-MILLER LABORATORIES
MAIN STREET, METUCHEN, NEW JERSEY
Telephone: Metuchen 6-2245

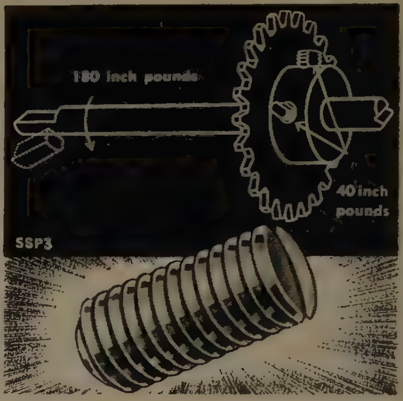
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 116A)

New Set Screw

Set Screw & Mfg. Co., 422 Main St., Bartlett, Ill., announces a new type of set screw, the "Nu-Cup."



The cup point of "Nu-Cup" is designed so that the user obtains increased holding power with the same amount of setting torque. The diameter of the cup circle is larger than that of the standard cup point, which makes a fuller contact possible and a deeper impression into the shaft, offering greater resistance to reversal, with the same setting torque. "Nu-Cup" distribution pressure is spread over a wider area, 20 to 25 per cent greater than conventional set screws.

"Nu-Cup" Set Screws are particularly suited to applications in which the shaft is soft, or is small in relation to the contact arc of the screw cup. The new set screws are made of an alloy steel, specially selected for hardness and offering exceptional capacity for pressure. They are available in slotted headless and slabbed type set screws only. A catalog is available by request.

Rotary Exhaust Tube Sealer

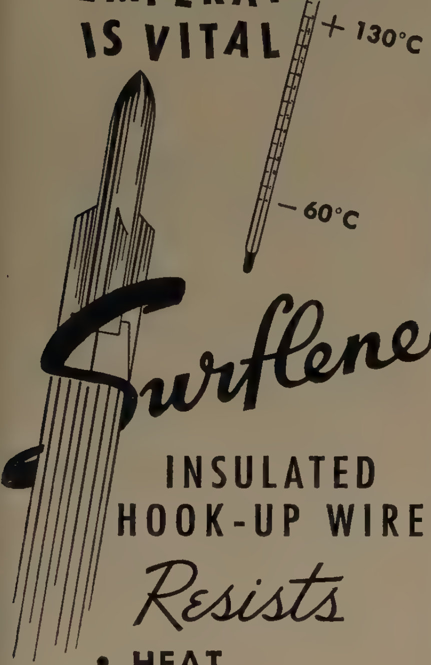
Consolidated Vacuum Corp., Rochester 4, N. Y., formerly the Vacuum Equipment Department of **Eastman Kodak's Distillation Products Industries,** announces the availability of a radically new high vacuum, high speed, exhaust and sealing machine for miniature and sub-miniature electron tubes.

There is no traditional slide valve at the center of the machine through which the tubes are vacuum pumped. Rather, pumping is accomplished by an easily demountable packaged unit consisting of mechanical pump, diffusion pump, valves, and compression port. This unit will produce a pressure of 1 micron or lower at the port in the positions immediately ahead of the tip-off.

Also, the machine is not indexing, that is, there are no starting and stopping motions. Once started up, the turret turns

(Continued on page 120A)

WHERE RESISTANCE TO HIGH AND LOW TEMPERATURES IS VITAL



Surflene

INSULATED HOOK-UP WIRE

Resists

- HEAT
- FUNGI
- ABRASION
- CHEMICALS

"Surflene", extruded monochlorotrifluoroethylene, has high insulation resistance, dielectric strength and outstanding resistance to heat, abrasion, most chemicals and concentrated acids, including fuming nitric acid. It is non-inflammable and inert to fungi. It is especially designed for hermetically sealed and water-proof equipment and for high temperatures encountered in power supply and continuous duty apparatus. Also available in multi-conductor cables.

"Surflene" is available in thirteen colors — red, orange, yellow, pink, light and dark green, blue, gray, tan, brown, black, white and clear.

Write our Engineering Service TODAY for technical assistance.

Surprenant MFG. CO.
199 Washington St. Boston 8, Mass. Plant—Clinton, Mass.
Engineered Wire and Cable for the Electronic and Aircraft Industries

BALLANTINE

STILL THE FINEST IN ELECTRONIC VOLTMETERS

Ballantine Model 300

SENSITIVE ELECTRONIC VOLTMETER

Featuring a Logarithmic Voltage Scale and Uniform Decibel Scale

PRICE . . . $200.

- Measures 1 millivolt to 100 volts over a frequency range from 10 to 150,000 cycles on a single logarithmic scale by means of a five decade range selector switch.
- Accuracy: 2% at *any* point on the scale over the ENTIRE RANGE.
- Input Impedance: ½ megohm shunted by 30 mmfds.
- Generous use of negative feedback assures customary Ballantine stability.
- Output jack and output control permit voltmeter to be used as a flat high gain (70DB) amplifier.
- Available accessories permit range to be extended up to 10,000 volts and down to 20 microvolts.
- Available Precision Shunt Resistors convert voltmeter to microammeter covering range from 1 to 1000 microamperes.

For additional information on this Voltmeter and Ballantine Battery Operated Voltmeters, Wide-Band Voltmeters, Peak to Peak Voltmeters, Decade Amplifiers, Inverters, Multipliers and Precision Shunt Resistors, write for catalog.

BALLANTINE LABORATORIES, INC.
102 Fanny Road, Boonton, N.J.

What is your Delay or Regulating Problem?

For the most effective solution use the
SIMPLEST, MOST COMPACT
MOST ECONOMICAL
HERMETICALLY SEALED

AMPERITE
THERMOSTATIC DELAY RELAYS

Provide delays ranging from 2 to 120 seconds.

- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- *Hermetically sealed.* Not affected by altitude, moisture, or other climate changes.
- Circuits: *SPST only*—normally open or normally closed.

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from −55° to +70°C. Heaters consume approximately 2 W. and may be operated continuously. The units are *most compact, rugged, explosion-proof, long-lived,* and—*very inexpensive!*

AMPERITE DELAY RELAY
STANDARD
MINIATURE

TYPES: Standard Radio Octal, and 9-Pin Miniature.

PROBLEM? Send for Bulletin No. TR-81

BALLAST-REGULATORS

- Amperite Regulators are designed to keep the current in a circuit ***automatically regulated*** at a definite value (for example, 0.5 amp).
- For currents of 60 ma. to 5 amps. *Operates on A.C., D.C., or Pulsating Current.*
- Hermetically sealed, light, compact, and most inexpensive.

AMPERITE REGULATOR
T9 BULB

BATTERY VOLTAGE 30 20 10
VOLTAGE OF 24V BATTERY & CHARGER VARIES APPROX 50%
WITH AMPERITE VOLTAGE VARIES ONLY 2%

7/8" MAX 2" ± 3/32 T6½L
3 9/16" MAX 1 11/64" OD MAX 5/8" T9

Maximum Wattage Dissipation: T6½L—5W. T9—10W.

Amperite Regulators are the simplest, most effective method for obtaining ***automatic regulation*** of current or voltage. ***Hermetically sealed,*** they are not affected by changes in altitude, ambient temperature (−55° to +90°C), or humidity. Rugged; no moving parts; changed as easily as a radio tube.

Write for 4-page Technical Bulletin No. AB-51

AMPERITE

AMPERITE CO., Inc. 561 Broadway, New York 12, N. Y.
In Canada: Atlas Radio Corp., Ltd., 560 King St., W., Toronto 2B

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 118A)

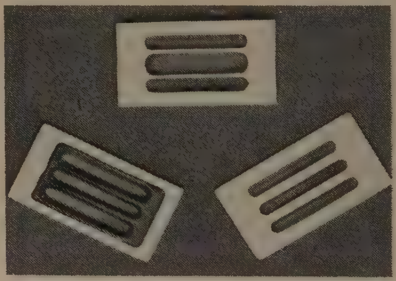
continuously, and sealing in of envelopes to base, transfer to pumping position, and finally tip-off are accomplished smoothly and automatically. Also, the continuous motion permits production rates 25 to 30 per cent greater than for conventional equipment.

In addition, only two large electric motors and one small are involved, thus greatly reducing maintenance. One large motor drives all the mechanical vacuum pumps through planetary gearing and clutch engagement. Another motor drives the turret, and a third is used to move the tube stems from the port after tip-off.

The machine can be made to index by adding several pieces which are designed to bolt into the base. No major redesign or alteration is necessary. It is normally supplied with 16 pumping and sealing heads, but this can be increased to 32 if a larger production rate is required.

Wide Band Microwave Window

Microwave Associates, Inc. 22 Cummington St., Boston 15, Mass., has a new microwave window which features the widest bandwidth of any glass-metal type heretofore used in the electronics industry. It covers a bandwidth of 4 per cent in the frequency range of 8,200–12,500 mc at a vswr less than 1.25. The vswr frequency characteristic behaves like a single resonant circuit with a minimum value of 1.03 in the neighborhood of 9,800 mc. The doubly loaded Q of the unit is approximately 0.25.



The window blank consists of three parallel slots stamped in a thin blank of kovar 0.600×1,100 inches O.D. to which is sealed a rectangular blank of low-gloss glass. The windows are copper and silver plated and may be soft soldered into a UG-39/U flat flange. It is necessary to mill out the flange to accommodate the window dimension and to break the inside edges of the waveguide at the flange connection to avoid cracking of the glass in the seal.

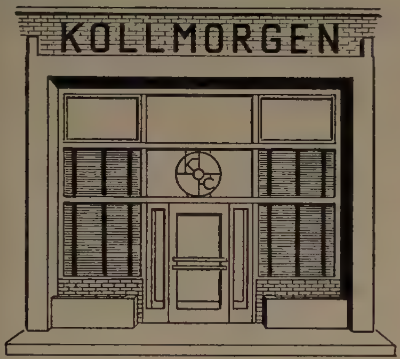
The windows may be used in pressurizing applications and will withstand pressures up to 30 pounds per square inch absolute.

Development of the window is an outgrowth of work done at S-band by a group at the Camp Evans Signal Laboratory under the direction of Kenton Caroff.

(Continued on page 124A)

OPTICAL SYSTEMS

INDUSTRIAL PERISCOPES



DESIGN

DEVELOPMENT

MANUFACTURE

For nearly half a century Kollmorgen has designed, developed and manufactured precision optics and optical systems for industry and the military.

We have the engineering "know-how", the design personnel and the manufacturing capacity to help you solve your optical problem.

KOLLMORGEN Optical CORPORATION

Plant: 347 King Street • Northampton, Mass.
New York Office
30 Church Street
New York 7, N.Y.

TIME-TRIED TETRODE

LOS GATOS 4D21/4-125A

MODERN in every respect—with exclusive Sintercote black-body high-dissipation anode and emission-free grids—the Los Gatos 4D21/4-125A provides a new source of supply for a widely-applied tetrode type. Check Los Gatos for your requirements in other types with emphasis on long service life.

LEWIS and KAUFMAN, Ltd.

LOS GATOS 2 CALIFORNIA

LOS GATOS LONG LIFE

SECON

DEVELOPMENT and PRODUCTION
METALLURGISTS

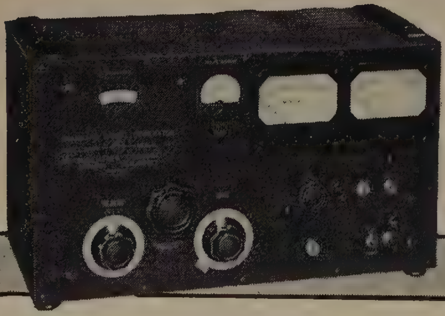
Fine wire and ribbon in base, rare, and
precious metals, and alloys for
new and highly engineered applications.
In small units and sizes,
and to close tolerances.

Further details on request.

SECON

SECON METALS CORPORATION
228 East 45th Street, N. Y. 17, N. Y., MU 7-1594

NEW! UHF TELEVISION
Standard Signal Generator



MODEL 84-TV
300—1000Mc.

SPECIFICATIONS
FREQUENCY RANGE: 300-1000 megacycles.
OUTPUT: .1 Microvolt to 1 Volt, across 50 Ohms.
OUTPUT IMPEDANCE: 50 Ohms coaxial.
MODULATION: Internal 400 cycle, continuously variable from 0 to 30%. Provision for external modulation of 50 to 20,000 cycles.
LEAKAGE: Negligible.
SIZE: Overall Dimensions: 11¾ inches high, 19 inches wide, 11 inches deep.
WEIGHT: Approximately 40 pounds.
POWER: 115 volts, 60 cycles, 120 watts.
Write for complete details

MANUFACTURERS OF
Standard Signal Generators
Pulse Generators
FM Signal Generators
Square Wave Generators
TV Standard Signal Generators
Vacuum Tube Voltmeters
UHF Radio Noise & Field Strength Meters
Megacycle Meters
Intermodulation Meters
TV & FM Test Equipment

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY

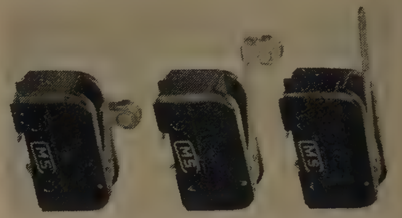
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 120A)

Low Force Switches

A new series of snap-action switches, designed for actuating forces as low as ½ ounce, is announced by **Micro-Switch,** a division of **Minneapolis-Honeywell Regulator Co.,** Freeport, Ill.



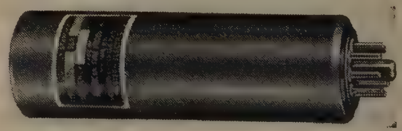
The switches are provided with rigid-lever integral actuators which adapt them to actuation by cams or by straight-line motion.

The new series is particularly useful in low-force, cam-actuated applications on timing clock motors, instruments, and meters. The switches also are widely used in rotary switch assemblies, in sequence switching gangs, and in general limit switch applications.

Type "W80" has a flat lever actuator designed for operation by straight-line motion or slow-moving cams. "W80" switches can be operated by a force as low as ½ ounce. Type "W82" switch has a hardened steel roller on the end of the lever for reducing friction in cam actuation. Type "W822" has a short roller lever actuator designed for fast cam actuation or for applications in which compactness and maximum resistance to vibration are required.

Each of these three types is available with solder lug or screw terminals. They are listed by Underwriters' Laboratories for 15 amperes, 125, 250 or 460 volts ac; ½ ampere, 125 volts, dc; ½ ampere, 250 volts, dc.

Hermetically Sealed Frequency Standard



American Time Products, Inc., 580 Fifth Ave., New York 36, N. Y., has developed a Type 2007 frequency standard which contains a shock mounted miniature high Q tuning fork, a sub miniature double triode tube and all circuitry. Output frequencies available are 400 or 500 cps with an accuracy of ±1 part in 50,000 from −15° to +35°C and ±1 part in 5000 from −65° to +85°C. Sealed in octal base container 1½ inch diameter×4½ inch high, weighing less than 10 ounces. Power required, 75 to 200 volts, dc at 1 to 5 ma and 6.3 volts at 300 ma. Designed to withstand MIL environment.

(Continued on page 125A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 124A)

Selenium Rectifier

Two high voltage selenium rectifiers, Type V-75HF and Type V100HF, have been developed by **International Rectifier Corp.,** El Segundo, Calif., for use in TV equipment in which long life and reliability are of importance.

The units are designed with ferrule terminals for insertion into standard 30-ampere fuse clips. The diameter of the units is $\frac{9}{16}$ inch. The Type V75HF is $3\frac{1}{4}$ inches long and the Type V100HF is $4\frac{5}{32}$ inches long. Both units are designed to deliver 5 milliamperes into a capacitive load at a dc output voltage of 1500 and 2000 volts respectively. These cartridge rectifiers are designed to meet JAN humidity, altitude, vibration and shock specifications. Both units have been incorporated into the horizontal oscillator circuit of video cameras.

(Continued on page 140A)

FIRST WITH THE FINEST IN . . .

- **CATHODE-RAY OSCILLOGRAPHY**
  Instrument Division,
  1500 Main Ave., Clifton, N.J.
- **CATHODE-RAY TUBES AND COMPONENTS**
  Cathode-ray Tube Division,
  750 Bloomfield Ave., Clifton, N.J.
- **TELEVISION TRANSMITTING EQUIPMENT**
  Television Transmitter Division,
  1500 Main Ave., Clifton, N.J.

DU MONT

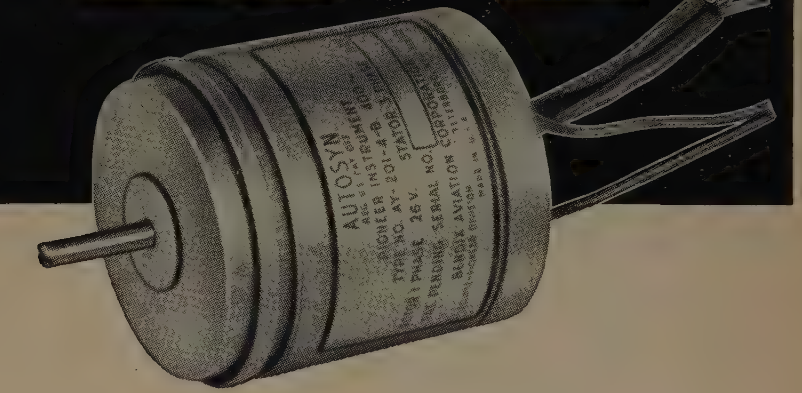
ALLEN B. DU MONT LABORATORIES, INC.

Autosyn*

SYNCHROS

Precision-Built by

ECLIPSE-PIONEER



For more than 18 years, Eclipse-Pioneer has been a leader in the development and production of high precision synchros for use in automatic control circuits of aircraft, marine and other industrial applications. Today, thanks to this long experience and specialization, Eclipse-Pioneer has available a complete line of standard (1.431″ dia. X 1.631″ lg.) and Pygmy (0.937″ dia. X 1.278″ lg.) Autosyn synchros of unmatched precision. Furthermore, current production quantities and techniques have reduced cost to a new low. For either present or future requirements, it will pay you to investigate Eclipse-Pioneer high precision at the new low cost.

*REG. TRADE MARK BENDIX AVIATION CORPORATION

AVERAGE ELECTRICAL CHARACTERISTICS—AY-200 SERIES**

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes
Transmitters	AY201-1	26V, 400~, 1 ph.	225	1.25	25+j115	11.8	9.5	3.5	15
	AY201-4	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	20
Receivers	AY201-2	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	45
Control Transformers	AY201-3	From Trans. Autosyn	Dependent Upon Circuit Design				42.0	10.8	15
	AY201-5	From Trans. Autosyn	Dependent Upon Circuit Design				250.0	63.0	15
Resolvers	AY221-3	26V, 400~, 1 ph.	60	0.35	108+j425	11.8	53.0	12.5	20
	AY241-5	1V, 30~, 1 ph.	3.7	—	240+j130	0.34	239.0	180.0	40
Differentials	AY231-3	From Trans. Autosyn	Dependent Upon Circuit Design				14.0	10.8	20

**Also includes High Frequency Resolvers designed for use up to 100KC (AY251-24)

AY-500 (PYGMY) SERIES

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes
Transmitters	AY503-4	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	25.0	10.5	24
Receivers	AY503-2	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	23.0	10.5	90
Control Transformers	AY503-3	From Trans. Autosyn	Dependent Upon Circuit Design				170.0	45.0	24
	AY503-5	From Trans. Autosyn	Dependent Upon Circuit Design				550.0	188.0	30
Resolvers	AY523-3	26V, 400~, 1 ph.	45	0.5	290+j490	11.8	210.0	42.0	30
	AY543-5	26V, 400~, 1 ph.	9	0.1	900+j2200	11.8	560.0	165.0	30
Differentials	AY533-3	From Trans. Autosyn	Dependent Upon Circuit Design				45.0	93.0	30

For detailed information, write to Dept. G.

ECLIPSE-PIONEER DIVISION of **Bendix** AVIATION CORPORATION
TETERBORO, NEW JERSEY

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

ENGINEERS

FOR ATOMIC
WEAPONS INSTALLATION

Mechanical Engineers, Electronics and Electrical Engineers, Physicists, Aerodynamicists, and Mathematicians. A variety of positions in research and development open for men with Bachelors or advanced degrees with or without applicable experience.

These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates the Laboratory under contract with the Atomic Energy Commission. The Laboratory offers excellent working conditions and liberal employee benefits, including paid vacations, sickness benefits, group life insurance and a contributory retirement plan.

LOCATE IN THE
Healthful Southwest

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. Albuquerque lies at the foot of the Sandia Mountains which rise to 11,000 feet. Cosmopolitan shopping centers, scenic beauty, historic interest, year 'round sports, and sunny, mild, dry climate make Albuquerque an ideal home. New residents experience little difficulty in obtaining adequate housing in the Albuquerque area.

APPLICATIONS NOW BEING ACCEPTED
FOR TECHNICAL WRITERS
▪
These are not Civil Service Appointments

Make Application to the
PROFESSIONAL EMPLOYMENT DIVISION
SANDIA
Corporation
SANDIA BASE
ALBUQUERQUE, N. M.

POSITIONS OPEN

The following positions of interest to I.R.E. members have been reported as open. Apply in writing, addressing reply to company mentioned or to Box No. . . . .

The Institute reserves the right to refuse any announcement without giving a reason for the refusal.

PROCEEDINGS of the I.R.E.
I East 79th St., New York 21, N.Y.

ENGINEERS, MATHEMATICIANS AND PHYSICISTS

The Moore School, University of Pennsylvania, has openings for electrical engineers, mathematicians and physicists. Work is available in the fields of digital and analogue computers, mathematical analysis, circuit design, and solid state physics. Applicants should be citizens and have at least a BA degree. Salary commensurate with experience. For information write: Professional Personnel Officer, Moore School, University of Pennsylvania, Phila. 4, Pa.

ELECTRICAL ENGINEERS

Electrical engineers with experience in communications and television system engineering required by a large organization in Montreal. Salary commensurate with ability and experience. Apply P. O. Box 6000, Montreal, Canada.

(Continued on page 128A)

UHF
and
MICROWAVE
ENGINEERS

This rapidly growing organization in South Central Wisconsin, which is approximately 100 miles from Chicago, Ill., has several openings for Junior and Senior Engineers in the UHF and Microwave Field.

UNUSUAL SALARY
OPPORTUNITIES

exist under ideal working conditions in large well equipped laboratories. Personnel benefits such as sickness, accident and life insurance in addition to a very liberal pension system are offered.

For more information concerning the positions that are open, we invite you to write to

Personnel Director, Dept. A.

GIBBS MANUFACTURING
& RESEARCH CORP.
Janesville, Wisconsin

WANT BETTER OPPORTUNITIES? TOP SALARIES PLUS OVERTIME FOR ENGINEERS PHYSICISTS TECHNICIANS

Write today for brochure outlining employment opportunities.

JACOBS
INSTRUMENT CO.
Bethesda, Maryland

Physicist or Electrical Engineer

to provide leadership and originality in the development of small electro-mechanical devices. Related experience desirable. High order of analytical ability essential. Under 35. Southeastern Pennsylvania industry beyond metropolitan area.

Box 727

The Institute of Radio Engineers
1 East 79 St., New York 21, N.Y.

Remington Rand Inc

UNIVAC

ENGINEERS

Electronic • Electro-Mechanical • Mechanical

The manufacturers of the UNIVAC—the first electronic, general-purpose, digital computer system to be sold commercially—have interesting and important positions with challenging futures. Engineers and physicists are needed for work at all levels in any of the following fields:

- System Studies
- Logical Design
- New Components
- Solid State Physics
- Semi-conductors
- Magnetic Materials
- Storage Techniques
- Circuit Design
- Pulse Techniques
- Input-Output Devices
- Product Design
- Test Equipment Design
- Computer Development and Design
- High Speed Electro-Mechanical Devices
- System Test and Maintenance

Design Research Development Test

Our rapidly expanding engineering and production programs have created many permanent positions paying excellent salaries. These positions offer outstanding opportunities for professional development. The possibilities for graduate study in this locale are excellent and the Company's plan for reimbursement of tuition expenses is extremely liberal. Other Company benefits include retirement and group insurance plans and the payment of moving expenses.

Replies kept strictly confidential. Interviews arranged at our expense.

REMINGTON RAND INC.
Eckert-Mauchly Division
2300 West Allegheny Avenue, Philadelphia 29, Pennsylvania
Telephone: BAldwin 3-7300.

ENGINEERS

Systems
Radar
Servo
Computer

You gain MORE with W. L. MAXSON. Top salaries . . . greater opportunities . . . more responsibilities. Advance with W. L. MAXSON.

BACKGROUND: Practical and research experience in Advanced Electronic Circuits and Systems Engineering DESIGN & ANALYSIS, related to: Instrumentation, Fire Control, Communications, Navigation, or Optical Fields. Ability in management & supervision desirable.

If your skills are now being fully utilized in a vital defense industry, please do not apply.

Kindly send resume and salary requirements to:

MAXSON

The W. L. MAXSON Corp.
460 W. 34th St., NEW YORK 1, N.Y.

News—New Products

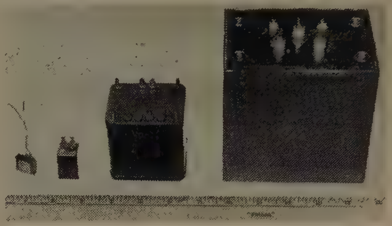
These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 125A)

Mil-T-27 Transformers

A.J.F. Industries, Inc., 852–858 Monroe St., Brooklyn 21, N. Y., is now producing in quantity hermetically-sealed transformers to MIL-T-27 specifications.

Facilities for complete in-plant-testing are available so that sample transformers do not have to be sent to government laboratories for test, thus saving considerable time.



A.J.F. has ASESA prototype approvals on many types of transformers. Therefore, in most cases MIL-T-27 approvals on new transformers may be obtained simply by comparing similarity to previously approved prototypes.

Sizes range from the sub-sub-miniature (less than ½ ounce) to 1 kv for the audio, power, plate, and filament for temperature rise of 40°C at 65°C ambient and are made grade 1 with can and also encapsulated without the can.

(Continued on page 142A)

COMMUNICATIONS ENGINEERS

- Design
- Project

A limited number of experienced engineers required for responsible positions in engineering departments. Specific projects include commercial carrier and radio systems as well as military equipment.

These are permanent positions with an expanding company offering good working conditions and liberal pension and insurance plans. Salaries are commensurate with training and experience.

Ideal location 20 miles south of San Francisco.

LENKURT ELECTRIC CO., INC.
San Carlos, Calif.

Lenkurt

DIGITAL COMPUTER ENGINEERS

ELECTRICAL ENGINEERS and PHYSICISTS

needed for circuit design and development. Engineers and Physicists with 1 to 4 years experience in pulse circuits, pulse handling techniques, and systems development. Openings also for recent graduates.

- Replies strictly confidential
- Interviews arranged at our expense

Engineering Research Associates
Division of Remington Rand Inc.
Leaders in the Development of Digital Computers
1902 W. Minnehaha, St. Paul 4, Minn. ■ "You Will Enjoy Living in Minnesota"

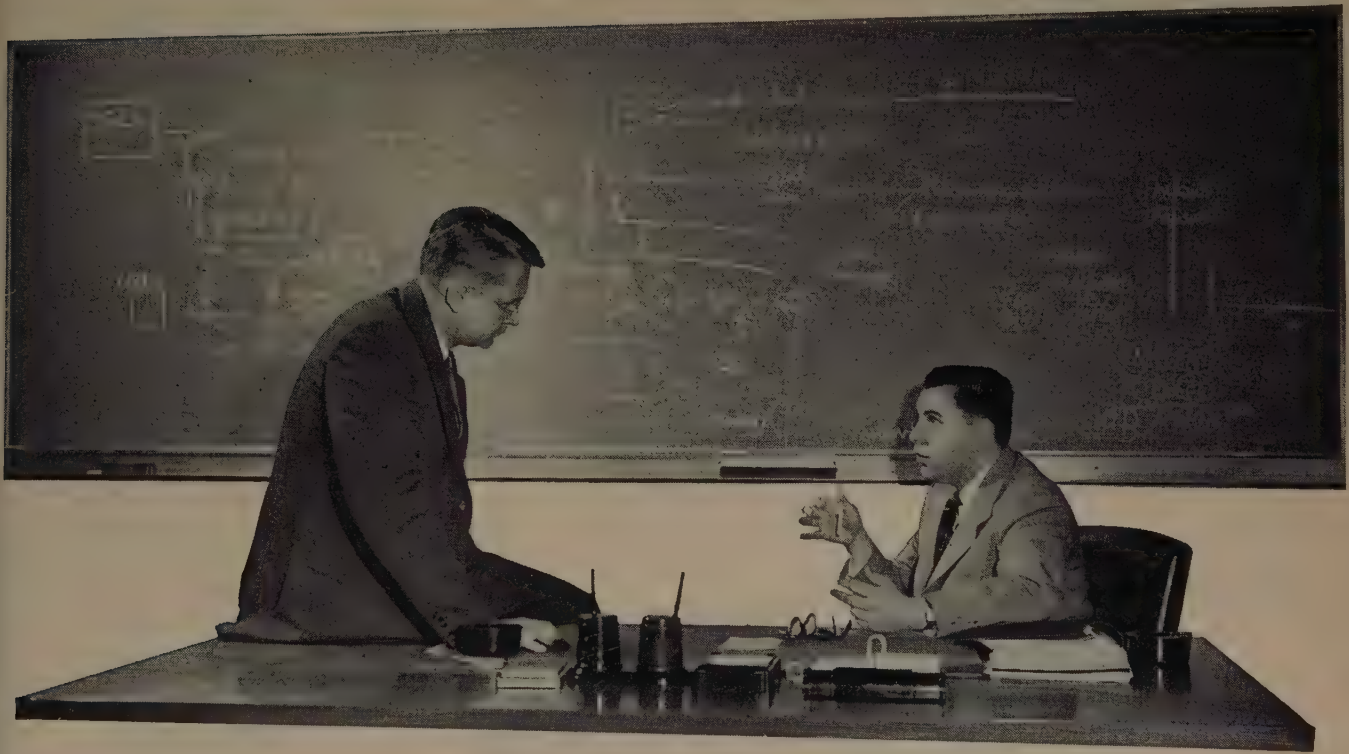
DEPARTMENT HEAD MISSILE ELECTRONICS

Prominent well-established aircraft and missile manufacturer offers an outstanding opportunity to a person qualified to head an expanding electronics organization. Salary commensurate with responsibility. Must have at least ten years experience in airborne electronics, five of which should be in missile or radar design and development. Advanced degree preferred. Position reports to chief engineer. Send detailed resume of background and recent photograph to

BOX 722
Institute of Radio Engineers
1 East 79 St., New York 21, N.Y.

PLANNING THE RIGHT ANSWERS

The complexity of modern air defense—extreme aircraft speeds, highly complex weapons, new combat strategies, the advanced state of today's technology—poses serious problems for the scientist and engineer.



One significant solution lies in the extensive use of airborne automatic equipment, including electronic digital computers, to augment or replace the human element in aircraft control.

AT HUGHES Research and Development Laboratories each problem is attacked basically, beginning with systems planning and analysis. This consists of an exhaustive examination of the requirements of a problem, together with an evaluation of the best means for satisfying these requirements. The objective is to design the simplest possible mechanization consistent with a superior performance.

These techniques, employing many special talents, are responsible at Hughes for the successful design, development *and* production of complexly interacting automatic systems for all phases of electronic control of interceptor navigation, flight control, and fire control. Similar accomplishments may be pointed to in the guided missile field.

Methods of systems planning and analysis responsible for achievements in the military area are also being applied at Hughes to adapt electronic digital computer techniques for business data processing and industrial controls.

Dr. E. C. Nelson (left), Head of Computer Systems Department, and J. H. Irving, Head of Systems Planning and Analysis Department, discuss a problem in the systems planning and analysis stage.

PHYSICISTS AND ENGINEERS

Hughes activities in the computer field are creating some new positions in the Systems Planning and Analysis Department. Experience in the design and application of electronic digital computers is desirable, but not essential. Analytically inclined physicists and engineers with a background in systems work are invited to apply.

Address:
SCIENTIFIC AND
ENGINEERING STAFF

HUGHES
Research
and Development
Laboratories

CULVER CITY,
LOS ANGELES COUNTY,
CALIFORNIA

KOLLSMAN INSTRUMENTS

Opportunities for

ENGINEERS

DESIGNERS

SR. TECHNICIANS

in radio and electronic

system development

KOLLSMAN INSTRUMENT CORP.

80-08 45th Avenue, Elmhurst, Long Island, New York

An invitation to

Engineers & Physicists

Investigate the outstanding record
of achievement and future plans of

melpar, inc.

The Research Laboratory
of Westinghouse Air Brake Co.
and its subsidiaries

Write to Personnel Director,
MELPAR, INC.
452 Swann Avenue
Alexandria, Virginia
or 10 Potter St., Cambridge, Mass.

MELPAR INC.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 140A)

Also, A.J.F. Industries is manufacturing high temperature 200°C transformers which are made hermetically sealed, and, too, are presently constructing pulse transformers ranging in size from trigger and blocking oscillator units of 300 volt peak secondary, to pulse units of 80 kw peak power and 10 kv peak volts.

Samples of most of power, audio, and filament types, built to customers' specifications, can be delivered in approximately three weeks and quantity deliveries can start in approximately six weeks after approval of samples.

For immediate action all inquiries should be marked for the attention of M. Clifford Agress.

Miniature Coax Connector

A "bee" size connector, completely assembled with single conductor cable which has been treated with conductive materials reducing the self-generated noise by a factor of 90 per cent is available from **Microdot Div., Felts Corp.,** 1826 Fremont Ave., South Pasadena, Calif. This treatment is important whenever high impedance terminations such as crystals, photocells and capacitive types are considered.

The Microdot Connector and associated cable is useable at frequencies up to

(Continued on page 144A)

●

ELECTRONIC ENGINEER WANTED

HERE IS THE
OUTSTANDING
CHALLENGE!

Former President of successful electronic instrument manufacturer needs a man to head up new research and development laboratory in . . .

SAN FRANCISCO BAY AREA

Well financed and directed. If interested send detailed resume with recent snapshot to Box 731.

INSTITUTE OF RADIO
ENGINEERS
1 East 79th St., New York 21, N.Y.

●

MOTOROLA INC. NEEDS

ELECTRONIC ENGINEERS

Experienced engineers for television receiver and circuit design. Experienced men also needed in U.H.F. and V.H.F. tuner design.

MECHANICAL ENGINEERS

Experienced mechanical engineers with a degree in M.E. or equivalent. Must have at least five years of actual design experience on electromechanical products.

RADIO ENGINEERS

Experienced in the design of broadcast and shortwave receivers for export use.

ELECTRO-CHEMISTS

Experienced electro-chemists needed in our fast growing plated circuit division.

Salaries commensurate with ability and experience. Excellent opportunities for advancement. More than the usual employee benefits.

Your reply will be kept in strictest confidence. Include a summary of your education, background and experience when you write to:

Personnel Department
Consumer Products Division
Motorola Inc.
4545 W. Augusta Blvd.
Chicago 51, Illinois

SPECIAL OPPORTUNITIES FOR

SENIOR ENGINEERS

Convair in beautiful, sunshiny San Diego invites you to join an "engineers" engineering department. Interesting, challenging, essential long-range projects in commercial aircraft, military aircraft, missiles, engineering research and electronics development. Positions open in these specialized fields:

Electrical Design
Mechanical Design
Structural Design
Structures
Weights
Servo-mechanisms
Aerodynamics
Thermodynamics
Operation Analysis
System Analysis

Generous travel allowances to those accepted. For free brochure, write Mr. H. T Brooks, Engineering Dept. 800

CONVAIR

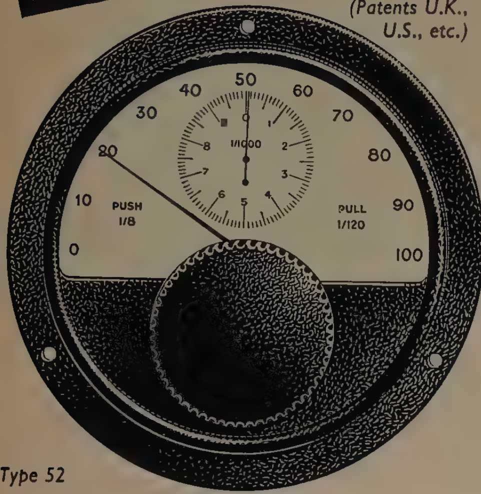
IN BEAUTIFUL

SAN DIEGO

3302 PACIFIC HIWAY
SAN DIEGO 12, CALIFORNIA

MICRODUAL
TWO-SPEED
PRECISION DRIVE

(Patents U.K., U.S., etc.)



Type 52

TWO SPEEDS · SINGLE CONTROL
FREE OF BACKLASH

Accuracy of scale reading 100%

Coarse searching speed plus fine setting control.

Single control knob displaced axially to select the speed ratio.

Spring-loaded gears with automatic take-up of any wear or play between primary and secondary drives.

Pointers geared directly to centre spindle.

Security in operation: friction clutch obviates overdriving.

TYPE No.	NUMBER OF DIAL MARKINGS	EFFECTIVE SCALE LENGTH	SPEED RATIOS	
			COARSE	FINE
52	1,000	3.3 feet	1 : 8	1 : 120
63	1,000	3.3 feet	1 : 8	1 : 120
57	2,000	6.6 feet	1 : 15	1 : 200
56	2,000	6.6 feet	1 : 15	1 : 200
53	2,000	6.6 feet	1 : 15	1 : 200

We are specially organized to handle direct enquiries and orders from U.S.A.
Billed in dollars. Settlement by your check.
CABLE OR AIRMAIL TO-DAY

TRANSRADIO LTD
CONTRACTORS TO H.M. GOVERNMENT
138A CROMWELL ROAD, LONDON, S.W.7., ENGLAND
CABLES — TRANSRAD, LONDON

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 142A)

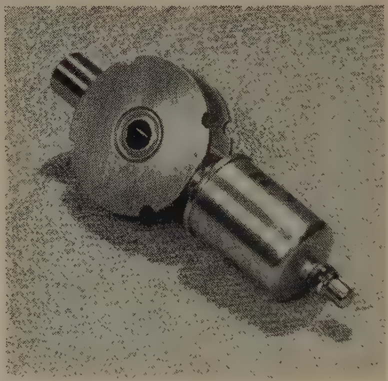
1,000 mc in short lengths with minimum insertion loss. The manufacturer states an insertion loss for 3 feet of cable and 2 complete male and female connectors of 0.9 db at 400 mc. The rated voltage of 600 volts RMS and the characteristic impedance of 50 ohms or higher indicates the applications to the audio, video, radio and radar applications.

The use of Teflon insulation for both cable and connectors insures broad temperature performance from 65° to +300°F. The small size of 0.220 inch diameter and length 0.85 inch (male and female) with 10.32 inch mounting thread provides easeful use for panel, chassis or blind hole mounting in microminiature assemblies. Vibration and moisture lock are provided through the use of "O" rings.

Associated couplings are available for use as chassis feed-throughs and for extending cable lengths.

Airborne Radar Tube

General Electric Co., Tube Dept., 1 River Rd., Schnectady 5, N. Y., announced that it has added to its TR tube line a new gas-switching tube for airborne radar.



The tube, type GL-1B24-A, is an integral-cavity tunable type designed for use in simple duplexers in pulsed microwave circuits which do not require that the short circuit in the tube have a fixed electrical position.

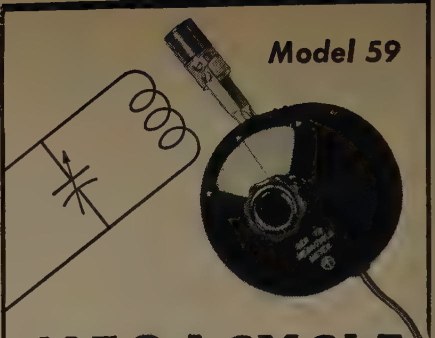
The tube differs from others of this type in that its reservoir is made of steel instead of glass. Use of a steel reservoir not only increases the tube's strength, but also decreases the weight appreciably. The tube weighs $\frac{1}{4}$ pound. Designed for use in an operation band from 8,490 to 9,600 mc, it operates to decouple the receiver effectively from a common transmitting and receiving antenna during a transmission period.

The GL-1B24-A has a recovery time of 4 μs at 10 kw peak, 3 db down. It has a leakage power of 30 mw. The transmitter peak power is 100 kw.

Further details on the GL-1B 24-A may be secured from the General Electric Co.

(Continued on page 145A)

Model 59



MEGACYCLE METER
2.2 mc. to 400 mc.
Frequency Accuracy ±2%

The MULTI-PURPOSE INSTRUMENT

- For determining the resonant frequency of tuned circuits, antennas, transmission lines, by-pass condensers, chokes, coils.
- For measuring capacitance, inductance, Q, mutual inductance.
- For preliminary tracking and alignment of receivers.
- As an auxiliary signal generator; modulated or unmodulated.
- For antenna tuning and transmitter neutralizing, power off.
- For locating parasitic circuits and spurious resonances.
- As a low sensitivity receiver for signal tracing.

And Many Other Applications

FREQUENCY: 2.2 mc. to 400 mc.; seven plug-in coils.

MODULATION: CW or 120 cycles; or external.

POWER SUPPLY: 110-120 volts, 50-60 cycles; 20 watts.

DIMENSIONS: Power Unit: 5⅛" wide; 6⅛" high; 7½" deep. Oscillator Unit: 3¾" diameter; 2" deep.

Write for Literature

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY

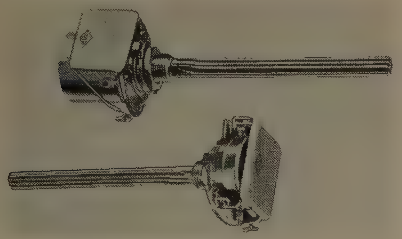
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 144A)

Compensated Volume Control

Compenthol is the new compensated volume control being manufactured by the **Centralab Div. of Globe Union, Inc.,** 900 E. Keefe Ave., Milwaukee 1, Wis.



The unit is a combination dual-tapped control and printed electronic-circuit plate combining the compensating network. The use of the PEC plate makes possible a size practically no larger than an ordinary volume control together with close control over the output of the entire network. Since all components in the "Compentrol" network are in shunt, there is no insertion loss, and no additional amplification is required.

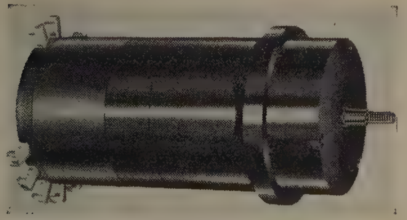
Compentrol has been designed as a direct replacement for standard controls in all audio equipment. It effectively compensates for the Fletcher-Munson hearing characteristic curves, boosting the very high and very low audio frequencies of sound at low volume level.

Two styles of Compentrol are now available, ½ and 1 megohm values, in both switch and nonswitch types.

Prices for Compentrol are $2.50 plain type audio net, $3.00 switch type audio net. A booklet describing "compensation" and the Compentrol unit is available free of charge at Centralab distributors, or by writing the company.

Electrical Resolvers

An electrical resolver system, capable of operating with accuracy over a wide environmental range, has been developed by the **Ford Instrument Co.,** 31-10 Thomson Ave., Long Island City 1, N. Y., for use in computers and computing systems.



The resolver system is composed of a resolver, a hi-gain amplifier, and a summing network box. The network box suitably combines its inputs for introduction into the hi-gain amplifier; the amplifier feeds the resolver, either the basic resolver

(Continued on page 146A)

NOW..Wire Lead Micas with 500 times better moisture resistance than ever before!

Sangamo HUMIDITITE* Mica Capacitors

When you use Sangamo HUMIDITITE molded Mica Capacitors, you gain all the advantages of an amazing moisture seal that offers previously unheard-of moisture resistance characteristics for compression molded plastic-encased mica capacitor components.

***what is HUMIDITITE?**

Humiditite is a remarkable new plastic molding compound, developed by Sangamo, that gives Sangamo Mica Capacitors moisture resistance properties far superior to any others on the market.

HERE'S THE PROOF . . . The standard moisture resistance test described in MIL-C-5A (proposed) Specification requires mica capacitors to offer at least 100 megohms of insulation resistance after ten 24 hour cycles in a humidity chamber at 90% to 95% relative humidity. The best competitive micas barely meet this requirement . . . but Sangamo HUMIDITITE Micas, *under the same conditions,* all tested in excess of 50,000 megohms! Continued tests, over and above requirements, with the same HUMIDITITE Micas, proved them capable of withstanding from 21 to 52 cycles (from the smallest sizes to the largest) before failure.

Humiditite is just another example of the advanced engineering that enables Sangamo to meet the existing and future needs of the electronic industry. For additional information about HUMIDITITE, write for Engineering Bulletin No. TS-111.

Those who know... choose Sangamo

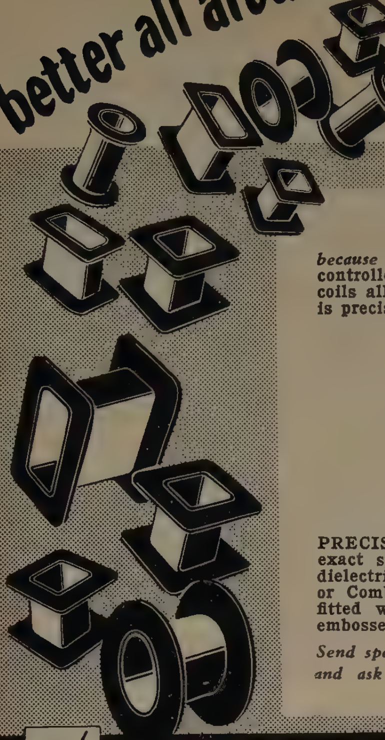
SANGAMO ELECTRIC COMPANY
MARION, ILLINOIS

SC53-5

better all around...

Precision

COIL BOBBINS



because PRECISION Coil Bobbins are quality controlled you can be sure they'll improve your coils all-around. Every PRECISION Coil Bobbin is precision-engineered to give you:

- Greater Insulation
- Better Heat Dissipation
- Higher Moisture Resistance
- 15 to 20% Greater Strength
- Lighter Weight
- More Winding Space

All at low unit cost!

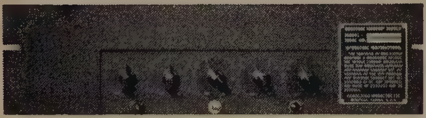
PRECISION Coil Bobbins can be designed to your exact specifications . . . any size or shape in dielectric Kraft or Fish Paper, Cellulose Acetate or Combinations. Flanges are supplied plain or fitted with leads, slots, holes—flat, recessed or embossed to fit any mounting.

Send specifications for free sample and ask for new Arbor list of over 1500 sizes.

PRECISION PAPER TUBE CO.

PRECISION

2051 W. Charleston St. Chicago 47, Ill.
Plant No. 2, 79 Chapel St., Hartford, Conn.
Also Mfrs. of PRECISION Paper Tubes



RACK MOUNTING MODELS

105-125 V, 60C INPUT

OUTPUT CURRENT MAY BE SET AT ANY VALUE BETWEEN 0.2 AND 50 M.A. D.C. INCLUSIVE.

AS LOAD VOLTAGE VARIES BETWEEN 0-150 V. MODEL IA-R IS CONSTANT WITHIN 1%. MODEL I B-R WITHIN 0.1%.

ELECTRONICALLY REGULATED

D.C. CONSTANT CURRENT POWER SUPPLIES

OUTPUT CURRENT IS HELD CONSTANT AS LOAD VARIES

OTHER MODELS AVAILABLE
WRITE DEPT. 101 FOR LITERATURE

ASSOCIATED SPECIALTIES CO.
1751 MAIN STREET
OREFIELD, PENNSYLVANIA

TOP HAT RETAINERS

An improved clamp that holds electron tubes, relays, capacitors and pluggable components in position.

WRITE FOR FREE CATALOG

EASY TO APPLY
INSTANTLY RELEASED
POSITIVE LOCKING ACTION

TIMES FACSIMILE CORPORATION
540 West 58 St., New York 19, N. Y.
1523 L St., N.W. Washington 5, D. C.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

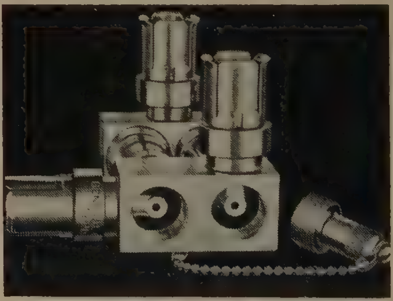
(Continued from page 145A)

or the vector solver type; the outputs of the resolver are the desired functions.

The following ratings and technical data are typical for the Ford resolver systems size 31 and size 23: frequency, 400 ±5 cps maximum; input voltage, 0.25–12.0 maximum; input impedance, 1.0 megohm; transformation ratio (at 8.0 volts input), 1±0°0′; variation of transformation ratio with input voltage from 0.25 v to 12.0 v, +0.06 per cent for size for size 31 system, +0.1 per cent for size 23 system; variation of transformation ratio with change in temperature (−60° to +160°F), +0.05 per cent for size 31 system, +0.1 per cent for size 23 system; maximum error of sine value during 360° rotor rotation (any one input voltage), +0.00060 for size 31 system, +0.00070 for size 23 system; maximum error of cosine value during 360° rotor rotation (any one input voltage), +0.00100; total null voltage (primarily 3rd harmonic), 1 mv/v input; error in null spacing, ±1½ minutes; inter axis error (rotor), ±3 minutes.

Balanced-Impedance Measurement

Accurate measurements of balanced impedances in a frequency range from 50 to 1,000 mc can be made with the help of a new transformer-type balanced impedance measurement device manufactured by **General Radio Co.,** 275 Massachusetts Ave., Cambridge 39, Mass.



Called the Balun, this tunable semi-artificial halfwave line makes it possible to connect a balanced impedance to an unbalanced coaxial system such as that used on high-frequency measuring instruments. The Balun has two important advantages over a conventional transformer. It can be tuned over a wide frequency range and has very low losses.

Since the use of balanced systems in television and communications has been growing rapidly, there has been a considerable need for a device to perform the functions of the Balun. The unbalanced end of the Balun is a type 874 coaxial connector, and thus can be used directly with any General Radio measuring equipment. New adaptors are available to connect to any of the other commonly used connector systems.

(Continued on page 147A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

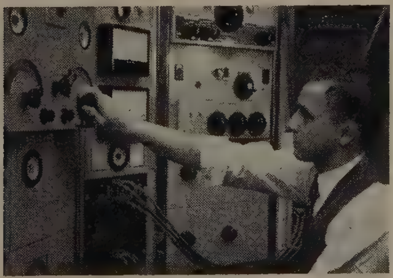
(Continued from page 146A)

Inductance Decades

Torocoil Co., 1374 Mobile Court, St. Louis 10, Mo., announces a complete line of decade-type inductance units. These units include four ranges from 1 mh to 10 henries and are available as single units which can be connected together to give an inductance change of as little as 1 mh in 10,000. These inductors are wound on the highest quality toroidally shaped powdered molybdenum permalloy cores. Quality Factors (Q) as high as 250 are obtainable with these units. Switching is performed by the use of high-current capacity, low-resistance, instrument type switches. Prices on these units are low enough so that every laboratory even with limited instrument budgets can afford the convenience of a precision set of high (Q) decade inductances. For further information write direct to the company.

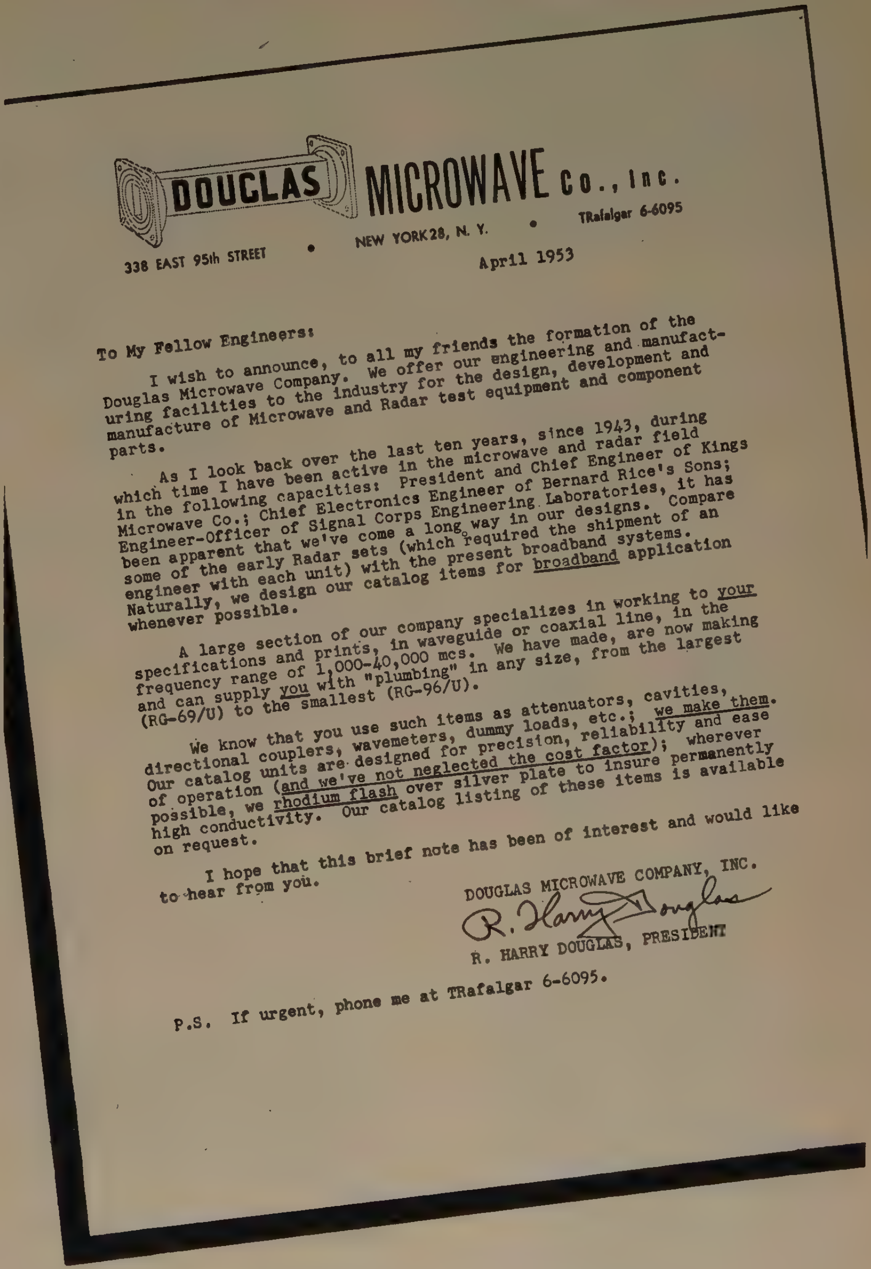
Coaxial Cable System

A new coaxial cable system, with triple the telephone capacity of those now in use, has been developed by **Bell Telephone Laboratories,** 463 West St., New York 14, N. Y., and is undergoing exhaustive field trials prior to use in the Bell System. It is expected to go into actual service on circuits between New York and Philadelphia early in 1953.



The new system, known as "L-3" carrier, will enable one pair of coaxial pipes to handle simultaneously more than 1,800 telephone conversations, or 600 telephone

(Continued on page 148A)



An Open Letter –

To Microwave Engineers

DOUGLAS MICROWAVE Co., Inc.
338 EAST 95th STREET • NEW YORK 28, N. Y. • TRafalgar 6-6095

April 1953

To My Fellow Engineers:

I wish to announce, to all my friends the formation of the Douglas Microwave Company. We offer our engineering and manufacturing facilities to the industry for the design, development and manufacture of Microwave and Radar test equipment and component parts.

As I look back over the last ten years, since 1943, during which time I have been active in the microwave and radar field in the following capacities: President and Chief Engineer of Kings Microwave Co.; Chief Electronics Engineer of Bernard Rice's Sons; Engineer-Officer of Signal Corps Engineering Laboratories, it has been apparent that we've come a long way in our designs. Compare some of the early Radar sets (which required the shipment of an engineer with each unit) with the present broadband systems. Naturally, we design our catalog items for broadband application whenever possible.

A large section of our company specializes in working to your specifications and prints, in waveguide or coaxial line, in the frequency range of 1,000-40,000 mcs. We have made, are now making and can supply you with "plumbing" in any size, from the largest (RG-69/U) to the smallest (RG-96/U).

We know that you use such items as attenuators, cavities, directional couplers, wavemeters, dummy loads, etc.; we make them. Our catalog units are designed for precision, reliability and ease of operation (and we've not neglected the cost factor); wherever possible, we rhodium flash over silver plate to insure permanently high conductivity. Our catalog listing of these items is available on request.

I hope that this brief note has been of interest and would like to hear from you.

DOUGLAS MICROWAVE COMPANY, INC.
R. Harry Douglas
R. HARRY DOUGLAS, PRESIDENT

P.S. If urgent, phone me at TRafalgar 6-6095.

Microwave {Test Equipment
Component Parts

Radar {Test Equipment
Component Parts

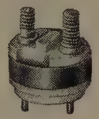
Some open territories for Sales Representation.

DOUGLAS MICROWAVE Co., Inc.
338 EAST 95th STREET • NEW YORK 28, N. Y. • TRafalgar 6-6095

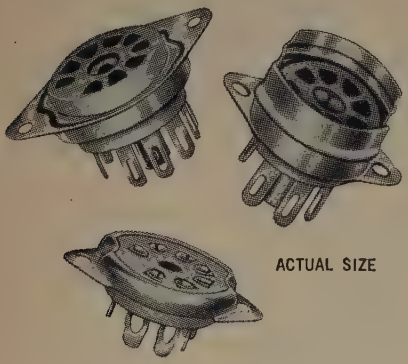
ELECTRICAL INSULATION THAT WILL TAKE 2000° F. FOR BRIEF PERIODS!

Aircraft fire detection apparatus needs that. Here is the Mycalex glass-bonded mica part that has it.

Mycalex 410 molded with steel ring inserts for thermo-coupling device produced by Thomas A. Edison, Inc.



● For permanent endurance Mycalex can take 650°F. continuously without heat distortion or any other injury.



ACTUAL SIZE

Mycalex is superior for high voltage, high frequency components that must operate in small spaces.

For example, tube sockets like these — now used in over 60% of all television receiver tuners. — Manufactured and sold by Mycalex Tube Socket Corporation, Clifton, N. J.

If your insulation must take heat or get rid of heat, investigate Mycalex!

WRITE FOR ENGINEERING DATA BOOK

SINCE 1919
MYCALEX
THE INSULATOR ®

MYCALEX CORPORATION of AMERICA
World's Largest Manufacturer of Glass-bonded Mica Products
Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.
GENERAL OFFICES AND PLANT
111 CLIFTON BOULEVARD, CLIFTON, N. J.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 147A)

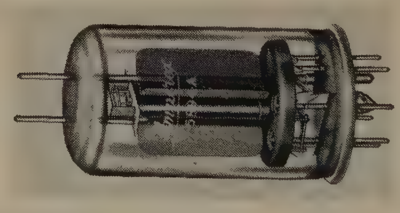
conversations plus one television program in each direction. It will be the first carrier system on which both television signals and regular telephone conversations can be sent over the same pair of coaxial pipes at the same time.

It was necessary to design new amplifiers or "repeaters" with characteristics exceeding any earlier type. In "L-3," as in earlier coaxial systems, power is fed to the repeaters over the coaxial cable from widely separated power points. The higher power requirements of the new repeaters, and the fact that twice as many are used in the new system, presented a number of technical problems.

New terminal equipment also was necessary to pile up 1,800 circuits and permit both addition and subtraction of smaller groups of circuits at intermediate points. Means for putting television signals on the line and distributing them at intermediate points without introducing distortion had to be developed. Sending both television and telephone signals over the same circuits created the problem of preventing interference between the two types of signals.

UHF-VHF Twin Tetrode

A new uhf and vhf tetrode is announced by the **Amperex Electronic Corp.,** 230 Duffy Ave., Hicksville, L. I., N. Y. Known as Model 5894-A, this new tube is a smaller, mechanically and electrically improved version of the Amperex AX-9903/5844 tube designed for wide band operation as an rf amplifier, modulator, frequency doubler, or a tripler.

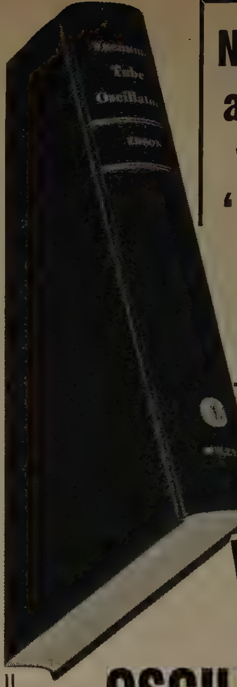


Improved hf performance is made possible because the cathode and grid structure is supported at the top as well as the bottom of the tube. Being thus held in exact vertical alignment with the plates, the two sections of the tube are in closer electrical balance.

The Amperex 5894-A employs a new type of construction which enables the tube to withstand greater shock and vibration. The anode seal strength has been increased by replacing the top section of the tube with a powdered glass seal. With this new construction, the maximum force on the ends of the anode pins perpendicular to the pin axle is about $14\frac{1}{2}$ pounds. With greater force, the pins bend without forming cracks in the glass.

Characteristics in brief: 250 mc, 85 watts output. 500 mc, 45 watts output. Filament voltage, Series 12.6 v; Parallel, 6.3v. Filament current, Series 0.9a; Parallel, 1.8a.

(Continued on page 150A)



Now . . . do away with wasteful "cut-and-try" methods

Read
VACUUM TUBE OSCILLATORS
By WILLIAM A. EDSON
Director of Electrical Engineering, Georgia Institute of Technology

Here is the volume engineers and designers have been waiting for . . . the very first comprehensive work on oscillator design and operation.

It covers the many factors affecting the behavior of oscillators, shows you how to *predict* this behavior, and how to design circuits to meet your specific needs.

You would have to scour through hundreds of books, journals, and bulletins to get all this valuable information. Instead, Edson has done the research for you, giving you in one handy source all the facts you need on electronics, circuit theory, and dynamics—for the clearest possible picture of oscillator operation. Each chapter is self-sufficient, making the volume a convenient handbook.

1952 476 pages 268 illus. $7.50

Fundamentals of ENGINEERING ELECTRONICS
2nd Edition
By WILLIAM G. DOW
University of Michigan
A realistic and quantitatively usable conception of the principles that govern the internal behavior of electronic devices.
1952 627 pages 272 illus. $8.50

STORAGE TUBES and Their Basic Principles
By M. KNOLL
Princeton University and RCA Laboratories
and B. KAZAN, *RCA Laboratories*
The first up-to-date coverage of *all* charge-controlled storage tubes.
1952 143 pages illus. $3.00

HOW TO PASS RADIO LICENSE EXAMINATIONS
Revised 3rd Edition
By CHARLES E. DREW
RCA Institutes, Inc.
"Clear-cut picture of the type of question which is asked of examinees."—*Radio News.*
1952 407 pages $5.75

FILTER DESIGN DATA FOR COMMUNICATION ENGINEERS
By J. H. MOLE
The Royal Naval Scientific Service
A quick, handy guide . . . practical, accurate, compact.
1952 252 pages $7.50

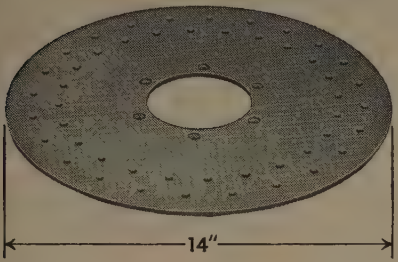
Write today for copies on 10-day approval

JOHN WILEY & SONS, Inc.
440 Fourth Avenue New York 16, N.Y.

ELECTRICAL INSULATION THAT CAN BE MADE TO THE SAME TOLERANCES AS STEEL

YES, we *do* mean *any* tolerances that can be produced in steel.

For example:



Two of these 14″ Mycalex 400 discs revolve with only .004″ clearance. Dimensionally stable, too. Mycalex *stays* accurate.

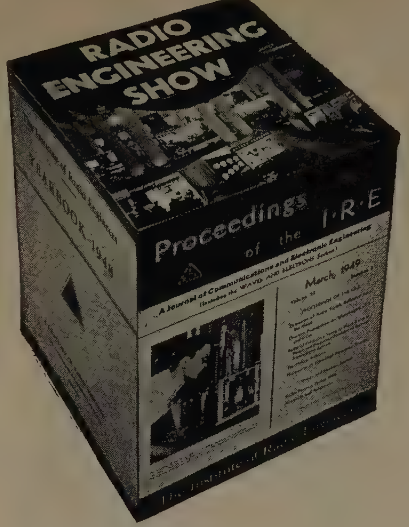
Mycalex glass-bonded mica is found in *HIGH PRECISION* electrical components.

WRITE FOR ENGINEERING DATA BOOK

SINCE 1919
MYCALEX
THE INSULATOR ®

MYCALEX CORPORATION of AMERICA
World's Largest Manufacturer of Glass-bonded Mica Products
Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.
GENERAL OFFICES AND PLANT
111 CLIFTON BOULEVARD, CLIFTON, N. J.

Great By-Product
of an engineering idea!



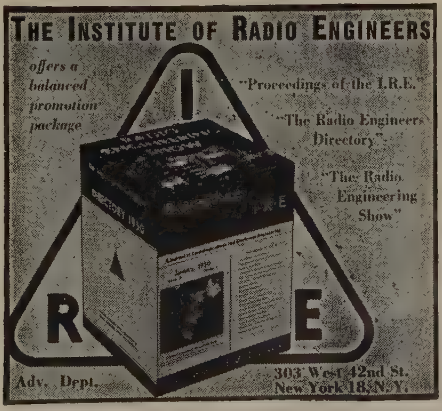
THE IRE Balanced Promotion Package

was an unexpected, but logical by-product of the Institute of Radio Engineers. The founding scientists and the thousands of radio men who were to apply for membership, and set and meet the engineering standards which are IRE today, did not recognize themselves as key men to a market.

△ But such men make a market! Only the engineer qualifies for technical buying in a scientific industry. Who else can "set the specs" for an electronic tube, component or instrument, except the design man who creates the circuit, and must make it work!

△ And so the "Proceedings of the I.R.E.", their monthly magazine; and "The Radio Engineers Directory", (the IRE Yearbook); and their Radio Engineering Show have become media to reach these buyers — all parts of a balanced package of product promotion, reference, and presentation, unparalleled for effectiveness — a great by-product of the IRE idea.

To SELL the Radio Industry
TELL the Radio Engineers.



THE INSTITUTE OF RADIO ENGINEERS

offers a balanced promotion package

"Proceedings of the I.R.E."

"The Radio Engineers Directory"

"The Radio Engineering Show"

Adv. Dept.

303 West 42nd St.
New York 18, N.Y.

IS THERE ANYTHING WRONG WITH MYCALEX?

YES

It's inelastic

- But inserts won't shake loose.

It has high density

- But permits reduction of overall size and weight.

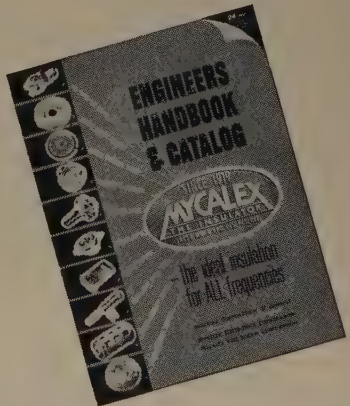
It has no color appeal

- But has certain surface finish interest.

MYCALEX GLASS-BONDED MICA
IS THE ONLY
CERAMOPLASTIC

The only material combining most of the best properties of ceramics and plastics, plus some of its own.

GET THE FULL, FRANK STORY


ENGINEERS HANDBOOK & CATALOG
MYCALEX
the ideal insulation for ALL frequencies

WRITE FOR ENGINEERING DATA BOOK

SINCE 1919
MYCALEX
THE INSULATOR ®

MYCALEX CORPORATION of AMERICA
World's Largest Manufacturer of Glass-bonded Mica Products
Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.
GENERAL OFFICES AND PLANT
111 CLIFTON BOULEVARD, CLIFTON, N. J.

HOLD THEM TIGHT with a

BIRTCHER CLAMP

There is a Birtcher Clamp ... *or one can be designed* ... for every tube you use or intend to use.

Regardless of the type tube or plug-in component your operation requires ... and regardless of the vibration and impact to which it will be subjected ... a Birtcher Tube Clamp will hold it securely and *rigidly* in place.

Catalog and samples sent by return mail.

The BIRTCHER CORPORATION
4371 Valley Blvd.
Los Angeles 32, Calif.

Please send catalog and samples by *return mail.*

Company __________ IRE 4-3
Attention of: __________
Address __________
City __________ State __________

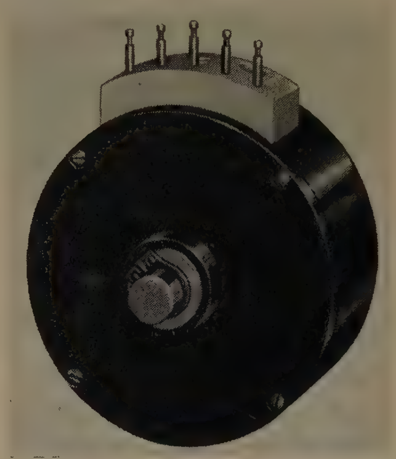
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 148A)

Potentiometer

A new 1¾ inch diameter, versatile potentiometer has been announced by **G. M. Giannini & Co., Inc.,** 117 E. Colorado St., Box N, Pasadena 1, Calif., and East Orange, N. J.



This new precision potentiometer is available in single-section units with either a syncro-type or screw-type mounting. Both sleeve bearing and ball bearing models are manufactured with torque requirements of 0.5 ounce/inch for the ball bearing unit. Standard linearity tolerance is ±0.3 per cent with better linearity units available on special order. Mechanical rotation can be 360° continuous, or stops can be provided for any rotation up to 330°. Electrical contact angles up to 360° can be ordered, but the standard contact angle is 356°. Resistances from 2,000 to 200,000 ohms are available with a power dissipation of 3 watts at an ambient temperature of +25°C. Operating temperature range is from −54 to +71°C and the unit will function during 50 G acceleration applied along any axis. The case is black anodized aluminum, and close tolerances are held on all mounting surfaces. With their toroid coils, these units are ideal for applications requiring nonlinear functional outputs without external taps. Weight is 2½ ounces for the sleeve bearing and 3½ ounces for the ball-bearing units.

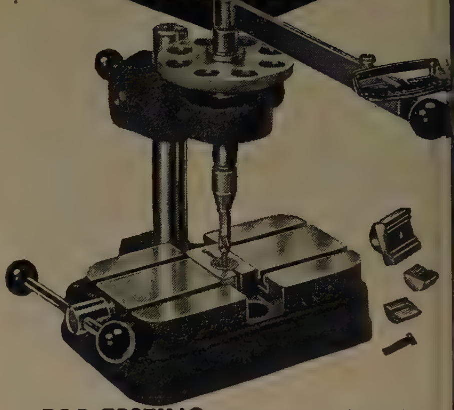
C-R Tube Increases Oscillograph Light Output

Incorporation of a Type 5XP-AM Metallized cathode-ray tube in the new Type 303-AH cathode-ray oscillograph was announced recently by the **Instrument Div. Allen B. Dumont Laboratories, Inc.,** 1500 Main Ave., Clifton, N. J.

The type 5XP-AM increases the light output from the screen by more than 50 per cent. Since the Type 303-AH is a high-voltage oscillograph often employed for the study of high-frequency signals of low repetition rates, or single transients, this is an advantage.

(Continued on page 151A)

STURTEVANT TORQUE TESTING FIXTURE



FOR TESTING Screws, thread-cutting and thread-forming screws—all types of threaded fasteners; threaded parts and threaded connections.

FOR MANUFACTURERS
DESIGNERS
INSPECTORS
TOOL ENGINEERS
LABORATORIES and for
PRODUCT CONTROL
in assembly.

Capacities: (0-200 in. lbs.) or (0-150 ft. lbs.)

Write for Bulletin TTF

P A STURTEVANT CO
ADDISON QUALITY ILLINOIS

Examine FREE

PULSE TECHNIQUES

by S. Moskowitz and J. Racker

Get this new self-training book for 10 days' free examination

Here is everything you need to know about pulse techniques—a subject of increasing importance in television, communications, and all electronic equipment. This book covers transient response of linear networks, design of pulse networks, pulse shaping and clamp circuits, pulse generation, measurement, and instruments, pulse communication systems, and aerial navigations aids.

PARTIAL CONTENTS: Fourier-transform method. Response of an ideal low-pass filter to a step voltage. Physical significance of response curves. Response to a pulse series. Determination of network response by Fourier transforms. Use of partial fractions in the solution of transform problems. Laplacian transform and inverse Laplacian of a step voltage. Typical network problems using L transforms. High-pass RC filter. Pulse transformers. Step-voltage build-up time response of a step-down transformer. Delay-time response. Special coaxial delay lines. Design of lumped lines. Supersonic delay lines. Shunt-peaking amplifier. Four-terminal coupling networks. Transmission-line amplifiers. Cathode follower. Limited circuits. Clipping circuits. Peak-riding clipper. Integrating circuits. Positive-bias restorer. Electron-coupled pulse oscillators. Relaxation oscillators. Multi-vibrators. Sweep circuits. Time calibration. Pulse-counting systems. Commutation. Modulation. Synchronization. Commercial pulse communication system. Introduction to radar systems. Timing unit. Radar receiver. Navar system. Loran system. **Get this authoritative handbook today! Coupon below brings you "Pulse Techniques" on FREE trial for 10 days. Mail it NOW!**

MAIL COUPON TODAY

Prentice-Hall, Inc., Dept. M-IRE-453
70 Fifth Avenue, New York 11, N.Y.

Please send me a copy of PULSE TECHNIQUES for FREE examination. Within 10 days I will either return the book and owe nothing, or keep it and remit $2.65 down (plus postage) and $2 monthly for 2 months.

Name ....
Address ....
City .... Zone .... State ....

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 150A)

Metallization also prevents the building up of spurious charges on the screen by successive transients. These spurious charges, under some circumstances, may distort succeeding transients.

Film fogging, a problem encountered when photo-recording with high-speed cameras, is also minimized by metallization. This fogging, partly caused by cathode glow passing through an unmetallized screen, may occur when the shutter is help open for a time, awaiting a single transient. In the Type 5XP-AM cathode glow cannot be transmitted through the metallized layer, thereby eliminating film fogging from this cause.

The price of the Type 303-AH with the Type 5XP-AM metallized cathode-ray tube remains unchanged, although the latter is more expensive than its unmetallized counter part.

Repeat Cycle Timer

An electronic repeat cycle timer suitable for regulation of automatic machinery, sampling, valve pacing and heat sealing as well as laboratory testing such as heat cycling and refluxing, is available from **G. C. Wilson & Co.**, 2 Passaic Ave., Chatham, N. J.

The timer uses a single electron tube to charge a resistance-capacitance network so that "on" cycles are adjustable from 0.2 to 200 and "off" cycles range from 0.1 second to 1 minute.

The unit is supplied in a sloping steel front cabinet, 6×6×6 inches for operation on 105–120 volt, 60 cps ac. Output is supplied to a double pole double throw relay for non-inductive loads up to 10 amperes at 115 volts or 2 amperes at 460 volts. Relay contacts are wired to a plug or a terminal strip to facilitate installation.

Applications include: refluxing, sign flashing, filter cleaning, heat cycling, life testing, food processing, sampling, electro plating, plastic molding, mixing machines, bag filling, bottle filling, valve metering and flight testing.

(Continued on page 152A)

BOLOMETER AMPLIFIERS

P & B Bolometer Amplifiers can be used wherever accurate, repeatable metering or recording of low level outputs is required. They were originally designed to facilitate the measurement of RF field strengths of antenna systems and RF networks, but in no sense are they limited to this field. In fact, they can be used effectively in any region of the radiation spectrum and in several fields of science: — chemistry, biology, nuclear physics and spectroscopy, to name a few.

Features of Model 100 Bolometer Amplifier

TUNABLE FREQUENCY RANGE — 400 to 5000 cycles (±3% calibration accuracy).

VARIABLE BANDWIDTH — (½ voltage) 6, 12, 22, 50, 100 and 300 cycles.

VOLTAGE RATIO EXPANDER — eighth power expander for the accurate measurement of extremely small variations.

AUTOMATIC NORMALIZATION — output voltage holds within ±¼ db for input changes of ±5 db to both signal and monitor channels.

SELF-CONTAINED METERING — Removable (up to 20 feet) voltmeter, logarithmic scale with 100 db decade.

RECORDER OUTPUT — .01 to 100 volts at .01 watt maximum (undecaded). Designed to operate strip-chart recorders for antenna pattern and standing wave ratio determinations.

MODEL 60 BOLOMETER AMPLIFIER

This model was designed to meet a demand for an inexpensive, yet highly accurate instrument not requiring the special features of the Model 100. *Write for Bulletin L-60.*

For complete information write for bulletin L-100.

PICKARD & BURNS
INCORPORATED
240 HIGHLAND AVENUE
NEEDHAM 94, MASS.

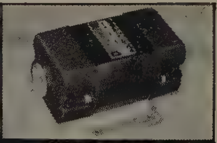
Pickard and Burns is a research, consulting, design and development organization with extensive laboratories and custom manufacturing facilities. It specializes in radio and microwave communications, radar and electronics. If you have problems in any of these categories, we shall be pleased to discuss them with you in complete confidence and without obligation.

COMPACT
DEPENDABLE
EFFICIENT
Rotary Power
by Carter

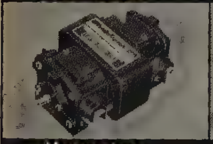
THE NEW
Custom
DC-AC CONVERTER

These latest of all Carter DC to AC Converters are specially engineered for professional and commercial applications requiring a high capacity source of 60 cycle AC from a DC power supply. Operates from storage batteries, or from DC line voltage. Three "Custom" models, delivering 300, 400, or 500 watts 115 or 220 V. AC. Wide range of input voltage, 12, 24, 32, 64, 110 or 230 V. DC. Unequalled capacity for operating professional recording, sound movie equipment and large screen TV receivers. Available with or without manual frequency control feature.

Dynamotors



Genemotors



Magmotors

Inductor Alternators

MAIL COUPON FOR CATALOG

Carter Rotary Power Supplies are made in a wide variety of types and capacities for communications, laboratory and industrial applications. Used in aircraft, marine, and mobile radio, geophysical instruments, ignition, timing, etc. MAIL COUPON NOW for complete Dynamotor and Converter Catalogs, with specifications and performance charts on the complete line.

Carter MOTOR CO.
2645 N. Maplewood Ave.
Chicago 47

Carter Motor Co.
2645 N. Maplewood Ave., Chicago 47
Please send new catalogs containing complete information on Carter "Custom" Converters and other Rotary Power Supplies.
Name____________________
Address____________________
City____________ State____________

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 151A)

Potentiometer Element

The Markite Corp., 155 Waverly Pl., New York 14, N. Y., has announced the availability of its type 2028 potentiometer element. This is a rectilinear model of 20,000 ohms resistance having an active length of 10 inches and a linearity of ±1 per cent. These elements are of particular interest in applications where the advantages of extreme wear resistance and substantially infinite resolution are important.

Markite has also developed a variety of rotational as well as rectilinear type elements and potentiometers to customer specifications.

Functional and linear designs are available offering combinations of wear resistance, precision, high resolution and adaptability to miniaturization over a wide impedance range.

(Continued on page 153A)

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES

RACK MODEL 33

STABLE
DEPENDABLE
MODERATELY PRICED

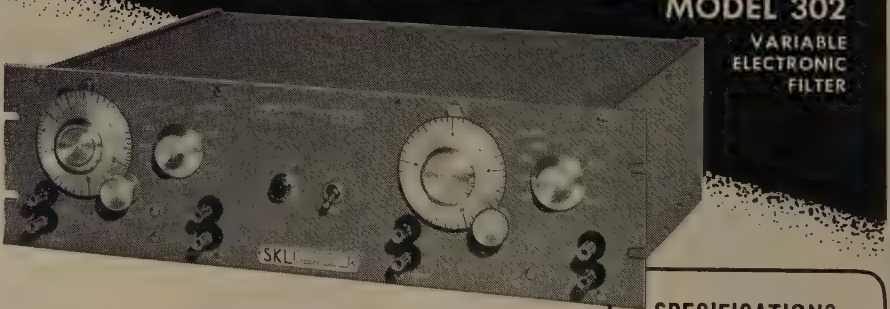
STANDARD RACK MOUNTING
PANEL SIZE 10½" x 19"
DEPTH 9"
WEIGHT 38 LBS

- INPUT: 105 to 125 VAC, 50-60 cy
- OUTPUT #1: 100 to 200 VDC at 300 ma regulated
- OUTPUT #2: 6.3 Volts AC CT at 5A unregulated
- OUTPUT #3: 6.3 Volts AC CT at 5A unregulated
- RIPPLE OUTPUT: Less than 10 millivolts rms

For complete information write for Bulletin N-3

LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

CONTINUOUSLY
VARIABLE FILTERS
MODEL 302
VARIABLE ELECTRONIC FILTER



Fast, Accurate, Reliable

The — SKL — Model 302 includes two independent filter sections, each having a continuously variable cut-off range of 20 cps to 200 KC. Providing a choice of filter types each section has 18 db per octave attenuation. When cascaded 36 db is obtained in the high and low pass setting and 18 db in the band pass position. With low noise level and 0 insertion loss this versatile filter can be used as an analyzer in industry and the research laboratory or to control sound in the communications laboratory, radio broadcasting, recording and moving picture industries.

SPECIFICATIONS
- CUT-OFF RANGE 20 cps to 200 KC
- SECTIONS 2—can be high, low and band pass
- ATTENUATIONS 36 db/octave maximum
- INSERTION LOSS . 0 db
- NOISE LEVEL 80 db below 1 volt
- FREQUENCY RESPONSE 2 cps to 4 MC

SKL SPENCER-KENNEDY LABORATORIES, INC.
181 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

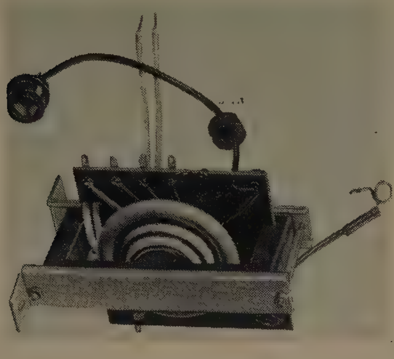
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 152A)

Flyback Transformers

Two flyback transformers, exact replacements for Admiral Parts, numbers 79C30-1, 79C30-3 and 79C30-4, are the latest in a complete line of horizontal output transformers just released by **Ram Electronic Sales Co.,** South Buckhout St., Irvington-on-Hudson, N. Y.



These two transformers are designed and constructed to the exact specifications of the set manufacturer and are guaranteed to equal or better the characteristics set up for them.

Both models are engineered for 66–70 degree horizontal deflection angle, utilize the new high-efficiency Ferrite "E" core, and deliver up to 15 kv with excellent stability for optimum performance of the circuit.

Ram builds a complete line of original equipment and replacement flybacks, yokes, linearity and width coils for television. For the latest catalog, write directly to Ram or see your local distributor.

Half-Wave Rectifier

A half-wave rectifier designed for use in high-voltage rectifier circuits has been added to the industrial tube line of the **General Electric Co., Tube Dept.,** 1 River Rd., Schnectady 5, N. Y.

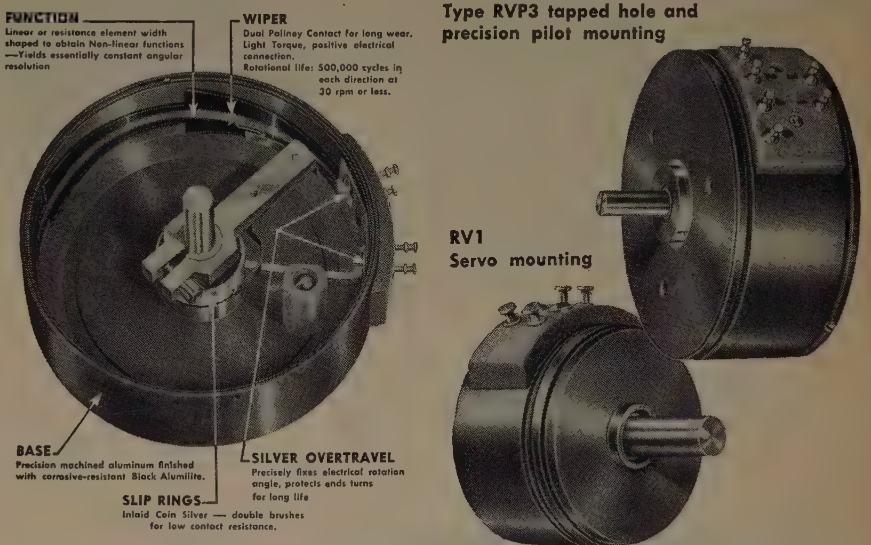
The tube, type GL-4B32, is designed particularly for use as a rectifier in radio and television transmitters, industrial heating oscillators, and other applications where high-voltage direct current is required.

The GL-4B32 is an inert-gas-filled tube which will operate over a wide temperature range, from −55° to +70°C. Use of

(Continued on page 154A)

TIE-TALKS FEATURE

PRECISION POTENTIOMETERS
of optimum accuracy
meeting your space requirements


FUNCTION
Linear or resistance element width shaped to obtain Non-linear functions —Yields essentially constant angular resolution
WIPER
Dual Paliney Contact for long wear. Light Torque, positive electrical connection.
Rotational life: 500,000 cycles in each direction at 30 rpm or less.
Type RVP3 tapped hole and precision pilot mounting
RV1
Servo mounting
BASE
Precision machined aluminum finished with corrosive-resistant Black Alumilite.
SLIP RINGS
Inlaid Coin Silver — double brushes for low contact resistance.
SILVER OVERTRAVEL
Precisely fixes electrical rotation angle, protects ends turns for long life

Technology Instrument Corporation potentiometers are designed for application in computing devices, instrumentation, electronic control and servo mechanisms — wherever extreme electrical and mechanical precision is an essential requirement.

As a result of years of custom manufacturing a complete line of standard sizes is available ranging from 7 inches in diameter to the sub-miniature ⅞" in diameter.

Custom design both mechanical and electrical is a featured TIC service. Precision non-linear pots may be designed to meet customer's requirements from either empirical data or implicit functions. Taps and special winding angles anywhere up to 360° continuous winding can be incorporated into both linear and non-linear precision potentiometers. Greatly expanded facilities plus mass production techniques meet customer volume needs yet maintain precision tolerances in both linear and non-linear potentiometers.

TYPE	DIAM.	RESISTANCE	ELECTRICAL ANGLE	LINEARITY	POWER RATING	MOUNTING	EXAMPLE OF NON-LINEAR FUNCTION AVAILABLE AS STANDARD
RVP-7	7"	1-500,000 Ω tol. to ± 1%	320° tol. to .5°	As low as .05%	6 watts at 25° C.	Servo	Type RVP7-S2 function: $\frac{E\ out}{E\ in} = \sin \Theta/2 \pm 0.1\%$ peak amplitude
RVP-3	[illegible]	Std. values to 200,000 Ω tol. to ± 1%	320° tol. to ± .5°	As low as ± .1%	6 watts at 25 C.	Servo—tapped hole and precision pilot or threaded bushing	Type RVP3-S4 function: 50 db logarithmic; conformity: ±2% constant fractional accuracy
RV-[illegible]	[illegible]	Std. values to 200,000 Ω tol. to ± 1%	315° tol. to ±1°	As low as ± .25%	8 or 12 watts	3 tapped hole	Available for non-linear functions Note: Phenolic base precision potentiometer, stainless steel or bakelite shaft
RV2	[illegible]	Std. values to 100,000 Ω tol. to ± 1%	320° tol. to ± .5°	As low as ± .2%	4 watts at 25 °C	Servo—tapped hole and precision pilot or threaded bushing	Type RV2-S112 function: R = KΘ², conformity: ± .5% over 64° to 320°
RV1-[illegible]	[illegible]	Std. values to 100,000 Ω tol. to ± 1%	320° tol. to ± 1°	As low as ± .25%	3 watts at 25° C.	Servo—tapped hole and precision pilot or threaded bushing	Type RV1 ⅝-S104 function: $\frac{E\ out}{E\ in} = \sin \Theta \pm 4\%$ peak amplitude per quadrant
RV1	1-1/16"	Std. values to 50,000 Ω tol. to ± 1%	320° tol. to ± 2°	As low as ± .5%	2 watts at 25° C.	Servo or threaded bushing	Type RV1-S7 function: $\frac{E\ out}{E\ in} = \sin \Theta/1.78 \pm 4\%$ of peak amplitude
LINEAR TYPES ONLY:							
RV-⅞	⅞"	Std. values to 40,000 Ω tol. to ± 1%	320° tol. to ± 3°	As low as ± .5%	1 watt	Servo or threaded bushing	
RVT Translatory 3¼" x 1⅞"		10,000 Ω ± 15%	Stroke* 2½"	± 1% total resistance	1 watt	Provides output proportional to a linear displacement rather than a rotary motion of a shaft	

* Special resistance values and stroke lengths from .5 inches to 15 inches can be provided on a custom basis.

TECHNOLOGY INSTRUMENT CORP.

535 Main Street, Acton, Massachusetts, Phone Acton 3-7711

LOST db LOCATED

MEASURE CONVERSION LOSS AND NOISE TEMPERATURE OF SILICON MIXER CRYSTALS

This portable self-contained instrument will indicate directly the conversion loss of all mixer crystals intended for use at or below 10,000 Mc. Above 10,000 Mc the readings are relative (crystals may be selected in the order of their quality). The instrument also indicates 30 Mc noise temperature. Conversion loss mean deviation ½ db; noise temperature mean deviation ½.

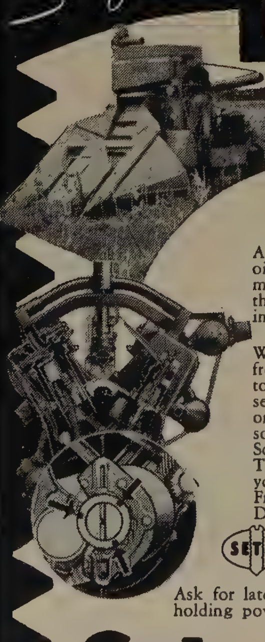
PAT. APP. FOR

PRODUCTION TESTING
INCOMING INSPECTION
FIELD TESTING

AS SIMPLE TO USE AS A VOLTMETER

Order AIL Type 390 $95.00 net
FOB Mineola, N. Y.

Airborne Instruments Laboratory
INCORPORATED
160 OLD COUNTRY ROAD, MINEOLA, N. Y.



ZIP-GRIP* Self-Locking SET SCREWS

are used on
MINNEAPOLIS MOLINE MM MODERN MACHINERY
Uni-Harvestor
...to lick vibration

A puzzling set screw problem in the oil pump on this multi-purpose farm machine was successfully solved by the use of three Zip-Grip* Self-Locking Set Screws.

Whatever your product, take a tip from makers of everything from tractors to TV sets, and see whether your set screw problems such as vibration or close-precision adjusting can be solved by Zip-Grip* Self-Locking Set Screws, which have exclusive "Contra-Thrust" action. Write us describing your application and we will send you Free Test Samples and Zip-Grip* Demonstrator.

SETKO SET SCREWS Meet All Regular Set Screw Needs.

Ask for latest stock list. If you want greater holding power with same setting torque, ask about new "Nu-Cup" Set Screws.

145

Set Screw & Mfg. Co.

FOR FREE CATALOG

Simply write your name and address on margin of this page, tear out and mail today.

422 Main St., Bartlett, Ill. (Chicago suburb)

*Pat. Pending

We Specialize in Solving Puzzling Set Screw Problems

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 153A)

an inert gas instead of mercury permits mounting the tube in any position.

Maximum ratings for the GL-4B32 include a peak maximum cathode current of five amperes, an average maximum cathode current of 1.25 amperes, and a maximum peak inverse anode voltage of 10,000 volts.

The tube is recommended for use with a filament voltage of five volts and a filament current of 7.5 amperes.

Further information on the GL-4B32 may be secured by writing the company.

Electric Auto-Camera

J. A. Maurer, Inc., Photographic Instrumentation Div., 37-01 Thirty-first St., Long Island City 1, N. Y., has just announced the availability to the American market of the Mark 3 model Auto-Camera as manufactured in England by D. Shackman & Sons.

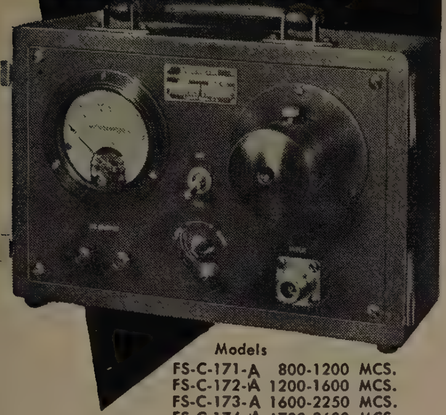
It may be used for all forms of data recording, such as study of repetitive processes, meter readings for future reference, motion study displacement study. Electrically operated with either 12 or 24 volt dc supply, the 21 foot film capacity cassettes with which this camera is loaded in daylight, will take either 200 exposures 1 inch×1 inch, (Model Mark 3-A) or 300 exposures ¾ inch×1 inch, (Model 3-B). Pulsing rate of exposure can be controlled from four per second to as long as necessary for the process being photographed. The camera is powered with a self-contained clock spring, the electrical impulse triggering the exposure and film transit and also closing an auxiliary contact for counter or signal light operation. When film has been fully exposed the camera locks out until reloaded, preventing spoilage of last picture.

As shipped, the lens is an f/3.5 of 35° inclusive angle of view, with five shutter speeds of 1/10th to 1/200th second and "time" exposure. A wide range of accessories from power supplies for line operation, to stands and adaptors for stereo, photo-micrography and similar applications are available. Weighing under 6 pounds the camera measures 9×3½×4 inches and adapts itself to close quarter operations. Full data can be had from J. A. Maurer, Inc.

(Continued on page 156A)

New 800-2600 MCS Frequency Meters

Lightweight-Portable Units . . For Field and Laboratory Use!



Models
FS-C-171-A 800-1200 MCS.
FS-C-172-A 1200-1600 MCS.
FS-C-173-A 1600-2250 MCS.
FS-C-174-A 1700-2600 MCS.

The input circuit is a type N connector (UG-58/U) . . . The output is monitored by a IN21B crystal and microammeter circuit with adjustable sensitivity control for varying input power levels. The output of the crystal may be obtained from pin jacks provided on the panel of the instrument. A switch is provided to change the output from the microammeter to the pin jacks.

SPECIFICATIONS

1. **ACCURACY**
   Better than .05% from 20°F to 120°F
2. **SENSITIVITY**
   Usable indication with 1 milliwatt input
   Adjustable for higher levels
3. **INDICATOR** 50 Microammeter
4. **INPUT**
   50 Ohm Type N Connector
5. **EXTERNAL DC OUTPUT**
   Pin Jacks
6. **EXCURSION OF MICROMETER**
   One-half inch
7. **MICROMETER SCALE**
   at 1000 Mc — 1 Division equals 290 KC
   at 1400 Mc — 1 Division equals 350 KC
   at 2000 Mc — 1 Division equals 450 KC
   at 2600 Mc — 1 Division equals 555 KC
8. **EXTERNAL SIZE** 6½ x 9¾ x 7"
9. **WEIGHT** Four pounds

CAVITY UNITS AVAILABLE

Units consist of cavity body, micrometer control, crystal, suitable connectors and calibration chart. Write for specifications and prices.

frequency standards

P. O. Box 504,
Asbury Park, New Jersey

---

new HEPPNER "GUARANTEED COUNT" ELECTRO-DYNAMIC speakers

With EXCLUSIVE "No-Rub" Voice Coil

ABSOLUTE UNIFORMITY TO YOUR SPECIFICATIONS BECAUSE:

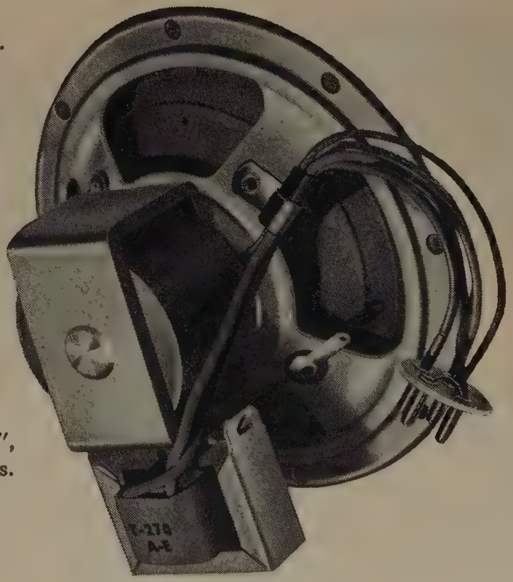
- **EACH FIELD COIL GUARANTEED TO CONTAIN GIVEN NUMBER OF TURNS** within standard tolerance. Quality fully controlled because all coils are wound by Heppner. No wire-stretching or other quality-reducing shortcuts. Resistance and wire size to your exact specifications.

- **THE *EXCLUSIVE* HEPPNER PERFECTLY ROUND "NO-RUB" VOICE COIL** is now available in Electro-Dynamic Speakers. This coil is installed perfectly round by means of a Heppner developed process which eliminates all egg-shaped coils which cause rubs.

Electro-Dynamic Speakers are available with or without bucking coils, transformers, plugs and/or brackets to your specifications.

Engineered for efficiency and fine acoustical performance. Exceptionally thorough final inspection.

Write for further information today.



Available in 3", 4", 5", 6½", 10", 12" sizes.

HEPPNER
MANUFACTURING COMPANY
Round Lake, Illinois (50 Miles Northwest of Chicago)
Phone: 6-2161
SPECIALISTS IN ELECTRO-MAGNETIC DEVICES

Representatives:
James C. Muggleworth
506 Richey Ave., W., Collingswood, N. J.
Ralph Haffey
2417 Kenwood Ave., Ft. Wayne 3, Indiana
Irv. M. Cochrane Co.
408 So. Alvarado St., Los Angeles, California

DeJUR

1½" Panel INSTRUMENTS

Precision built DeJUR 1½" instruments for applications where space must be conserved. DeJUR rugged construction. Both models in all ranges and sensitivities. External shunts and multipliers available for various ranges. Complete magnetic shielding and methods of lighting scales. Built to meet government specifications.

DeJUR MODEL 120

Aluminum Case
•
One Hole Ring Mounting

- **DC VOLTMETERS**
- **AMMETERS**
- **MILLIVOLT METERS**
- **MILLIAMMETERS**
- **AC RECTIFIER TYPES (self-contained).**

ACTUAL SIZE

DeJUR MODEL 112

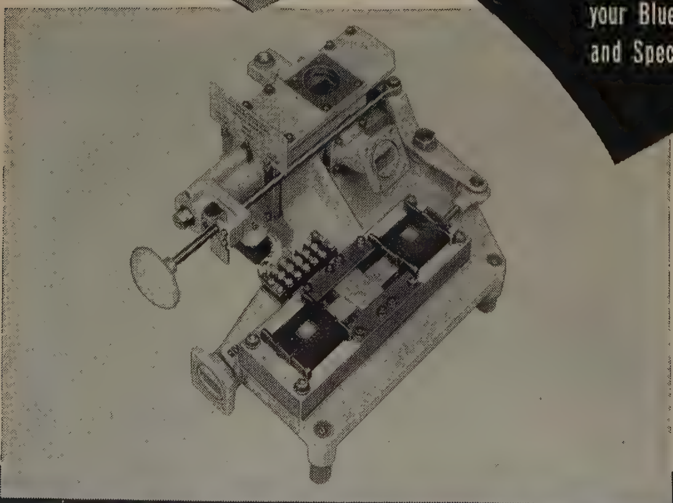
Also available • 2½" • 3½" • 4" panel meters in all standard ranges. MIL-M-6A and A. S. A.
REQUEST CATALOG P-4

DeJUR USA

DeJUR **AMSCO CORPORATION**
45-01 NORTHERN BOULEVARD, L. I. C. 1, N. Y.
MANUFACTURERS OF SCIENTIFIC PRECISION EQUIPMENT FOR OVER A QUARTER OF A CENTURY
• CAMERAS • PROJECTORS • ENLARGERS • EXPOSURE METERS •

NRK

Microwave Assemblies, Radar Components, and Precision Instruments . . . manufactured to your Blueprints and Specifications.



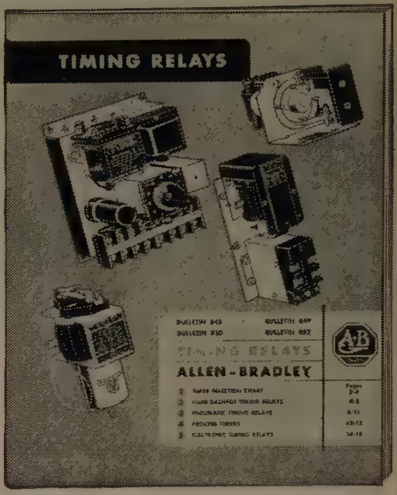
N.R.K. MFG. & ENGINEERING CO.
4601 WEST ADDISON STREET • CHICAGO 41, ILL. • SPring 7-2970

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 154A)

Bulletin on Timing Relays



The Allen-Bradley Co., 136 W. Greenfield Ave., Milwaukee, Wis., is offering a 16-page bulletin featuring its complete line of timing relays.

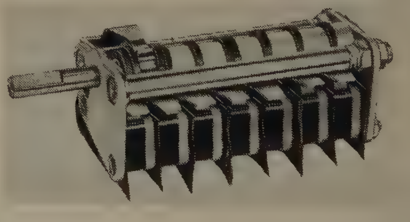
Fluid dashpot, pneumatic, and electronic timers are fully described. It also contains complete operation and engineering data. Applications are clearly stated. Timers are shown in a wide variety of standard enclosures.

A selector chart is provided along with suggestions on the various factors to consider in choosing a timing relay for a particular application.

A request to the company will be filled promptly.

Switch Assembly

A new series of extremely small size multiple rotary switch assemblies, designed for aircraft use but adaptable to a wide variety of either ac or dc switching applications, is announced by **Micro Div., Minneapolis-Honeywell Regulator Co.**, Freeport, Ill.



One of the series is a ganged assembly of seven "V3" type basic switches with single-pole, double-throw contact arrangement. Each "V3" basic switch measures $\frac{13}{32}\times\frac{5}{8}\times1\frac{3}{32}$ inches, and the entire assembly measures $1\frac{1}{2}\times1\frac{5}{8}\times4\frac{3}{4}$ inches. The dc rating of the 7AS71 (Catalog Listing) assembly for inductive and heater load is: 30 volts, 10 amperes at sea level; 30 volts, 6 amperes at 50,000 feet altitude. The ac

(Continued on page 158A)

COMMUNICATIONS EQUIPMENT CO.

PULSE TRANSFORMERS

D-166173: Video, Ratio = 50:900 Ohms 10KC—2MC ... $12.50

G.E.K.-2745 ... $39.50

G.E.K.-2744-A, 11.5 KV High voltage. 3.2 KV Low voltage @ 200 KW oper. (270 KW max.) 1 microsec. or 1/microsec. @ 600 PPS ... $39.50

W.E. D169271 Hi Volt Input pulse Transformer ... $27.50

G.E. K2450A. Will receive 13KV, 4 micro-second pulse on pri. secondary delivers 14KV. Peak power out 100 KW G. E. ... $34.50

G. E. K2748A. Pulse Input line to magnetron ... $36.00

Ray UX 7896—Pulse Output Pri. 5v. sec. 41v ... $7.50

Ray UX 8442—Pulse inversion—40v + 40v ... $7.50

Ray UX 7361 ... $5.00

PHILCO 352-7250, 352-7251, 352-7287

UTAH 9332, 9278, 9341.

RAYTHEON: UX8693, UX5986 ... $5 ea.

W.E.: D-166310, D-16638, KS 9800, KS9948

PULSE EQUIPMENT

APQ-13 PULSE MODULATOR. Pulse Width .5 to 1.1 Micro Sec. Rep. rate 624 to 1348 Pps. Pk. Pwr. out 35 KW Energy 0.018 Joules ... $49.00

TPS-3 PULSE MODULATOR. Pk. power 50 amp. 24 KW (1200 KW pk): pulse rate 200 PPS. 1.5 microsec. pulse line impedance 50 ohms. Circuit series charging version of DC Resonance type. Uses two 705-A's as rectifiers. 115 v. 400 cycle input. New with all tubes ... $49.50

DELAY LINES

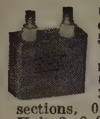
D-168184: 0.5 microsec. up to 2000 PPS 1800 ohm term ... $4.00

D-170499: 25/.50/.75 microsec. 8 KV 50 ohms imp. ... $16.50

D-165997: 1¼ microsec. ... $7.50

RCA 255686-502, 2.2μ sec. 1400 ohms ... $2.00

PULSE NETWORKS



G.E. ‡6E3-5-2000-50P2T. 6KV "E" circuit, 3 sections .5 microsecond, 2000 PPS 50 ohms impedance ... $6.50

15A—1-400-50: 15 KV, "A" CKT. 1 microsec. 400 PPS. 50 ohms imp. $37.50

G.E. ‡3E (3-84-810) 8-2.24-405) 50P4T; 3KV "E" CKT Dual Unit; Unit 1, 3 sections, 0.84 Microsec. 810 PPS, 50 ohms imp.: Unit 2, 8 Sections, 2.24 microsec. 405 PPS. 50 ohms imp. ... $6.50

7-5E3-1-200-67P. 7.5 KV "E" Circuit, 1 microsec 200 PPS, 67 ohms impedance 3 sections ... $7.50

7-5E4-16-60, 67P. 7.5 KV. "E" Circuit, 4 sections 16 microsec. 60 PPS. 67 ohms impedance ... $15.00

7.5E3-3-200-6FT, 7.5 KV. "E" Circuit. 3 microsec. 200 PPS. 6 ohms imp. 3 sections ... $12.50

‡755: 10KV, 2.2usec., 375 PPS. 50 ohms imp. ... $27.50

‡754: 10KV. 0.85usec., 750 PPS. 50 ohms imp. ... $27.50

KS8865 CHARGING CHOKE: 115-150H @ .02A, 32-40H @ .08A, 30,700V Corona Test, 21KV Test ... $37.50

G.E. 25E5-1-350-50 P2T. "E" CKT, 1 Microsec. Pulse @ 350 PPS. 50 OHMS Impedance ... $69.50

400 CYCLE TRANSFORMERS

(All Primaries 115V, 400 Cycles)

Stock	Ratings	Price
M-7467886	2X140V/.014A, 120V/.012A, 1200 VRMS TEST, P/O MX-8/APG-2	$ 4.95
352-7102	6.3V/2.5A	1.45
M-7472426	1450V/ MA, 2,5V/.75A, 6.4V/3.9A, 5V/2A, 6.5V/.3A, P/O ID-39/APG-13	4.95
352-7039	640VCT @ 250MA, 6.3V/.9A, 6.3V/6A, 5V/6A	$5.49
702724	9800/8600 @ 32MA	8.95
K59584	5000V/290MA, 5V/10A	22.50
52J652	13,500V/3.5MA	14.65
KS9607	734VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V/0.9A, 6.3V 2.5A 6.3V/.06A, 5V/CA	6.95
352-7070	2X2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/1000/75 OV @ .005A	7.45
352-7196	1140V/1.25MA, 2.5V/1.75A, 2.5V/ 1.75A —5KV Test	3.95
352-7176	320VCT/50MA, 4.5V/3A, 6.3VCT/20A, 2X6.3VCT/6A	4.75
RA6400-1	2.5V/1.75A, 6.3V/2A—5KV Test	2.39
901692	13V 9A	2.49
901699-501	2.77V @ 4.25A	3.45
901698-501	900V/75MA, 100V/.04A	4.29
UX8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/80MA, 5V/3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300 VCT, 135MA	5.95
KS 9336	1100V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/21A	4.25
KS 8984	27V/4.3A, 6.3/2.9A, 1.25V/.02A	2.95
52C080	526VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
68G631	1150-0-1150V	2.75
80G198	6VCT/.00006 KVA	1.75
302433A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5V/3.5A	4.85
KS 9445	592VCT/118MA, 6.3V/8.1A, 5V/2A	5.39
KS 9685	6.4/7.5A, 6.4V/3.8A, 6.4V/2.5A ALL CT	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95

MICROWAVE COMPONENTS

S BAND—3" x 1½" WAVEGUIDE

DIRECTIONAL COUPLER, Broadband type "N" Coupling. 20 db. with std. flanges. Navy ‡CABV 47AAN-2. As shown ... $37.50

WAVEMETER, 2700-3400 MC, Reaction type with counter Dial—Mfg., W.E. ... $92.50

REACTION WAVEMETER, Mfg. G.E. 3000-3700 MC, Mic. Head ... $125.00

LHTR. LIGHTHOUSE ASSEMBLY. Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG, To Recvr. Uses 2C40, 2C43, 1B27, Tunable APX 2400-2700 MCS, Silver Plated ... $49.50

BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice, each ... $47.50

MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated ... $45.00

RT-39 APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr-TR, cavity compl. recvr. & 30 MC IF strip using 60K5 (2C40, 2C43, 1B27 lineup) w/Tubes.

721A TR BOX complete with tube and tuning plungers ... $12.50

McNALLY KLYSTRON CAVITIES for 707B or 2K28 ... $4.00

F 29 SPR-2 FILTERS, type "N" input and output ... $12.50

WAVEGUIDE TO ⅞" RIGID COAX "DOOR-KNOB" ADAPTER CHOKE FLANGE, SILVER PLATED BROAD BAND ... $32.50

AS14A AP-10 CM Pick up Dipole with "N" Cables ... $4.50

OAJ ECHO BOX, 10 CM TUNABLE ... $22.50

HOMERELL-TO-TYPE "N" Male Adapters. W.E. ‡D167284 ... $2.75

I. F. AMP. STRIP: 30 MC. 120 d.b. gain, 2 MC Bandwidth, uses 6AC7's—with video detector. Less tubes ... $24.50

POLYROD ANTENNA, AS31/APN-7 in Lucite Ball. Type "N" feed ... $22.50

ANTENNA, AT49A/APR: Broadband Conical. 300-3300 MC Type "N" Feed ... $12.50

"E" or "H" PLANE BENDS. 90 Deg. less flanges ... $7.50

⅞" RIGID COAX—⅜" I.C.

RIGHT ANGLE BEND, with flexible coax output pickup loop ... $8.00

SHORT RIGHT ANGLE BEND, with pressurizing nipple ... $3.00

RIGID COAX to flex coax connector ... $3.50

RT. ANGLES for above ... $2.50

RT. ANGLE BEND 15" L. OA ... $3.50

FLEXIBLE SECTION. 15" L. Male to female $4.25

⅞" RIGID COAX. BULKHEAD FEED-THRU ... $14.00

⅞" RIGID COAX—⅜" I. C.

ROTARY JOINT. Stub-supported, UG 46/UG 45 fittings ... $27.50

10 CM STABILIZER Cavity, tunable, standard UG46/UP 45 fittings ... $45.00

RG 44/U RIGID COAX, stub support, 5 ft. sections, with UG46/UG45 connectors ... $12.50

RIGHT ANGLE BEND, with flexible coax output pickup loop ... $8.00

SHORT RIGHT ANGLE BEND, with pressurizing nipple ... $3.00

RIGID COAX to flex coax connector ... $3.50

RT ANGLES for above ... $2.50

RT. ANGLE BEND 15" L. OA ... $3.50

FLEXIBLE SECTION, 15 L. Male to female. $4.25

⅞" RIGID COAX. BULKHEAD FEED-THRU ... $14.00

X BAND—1" x ½" WAVEGUIDE

1" x ½" waveguide in 5' lengths, UG 39 flange to UG40 cover ... **per length $7.50**

Rotating joints supplied either with or without deck mounting. With UG40 flanges ... **each, $17.50**

Bulkhead Feed-thru Assembly ... $15.00

Pressure Gauge Section 15 lb. gauge and press nipple ... $10.00

Pressure Gauge, 15 lbs. ... $2.50

Directional Coupler, UG-40/U Take off 20 db. $17.50

TR-ATR Uuplexor section for above ... $8.50

Waveguide Section 12" long choke to cover 45 deg. twist & 2½" radius. 90 deg. bend ... $4.50

Twist 90 deg. 5" choke to cover w/pres nipple $6.50

Waveguide Section 2½ ft. long silver plated with choke flange ... $5.75

Rotary joint choke to choke with deck mounting ... $17.50

3 cm. mitered elbow "E" plane ... $12.00

UG 39 Flanges ... $ .85

90 degree elbows. "E" or "H" plane, 2½" radius ... $12.50

90 degree twist 6" long ... $8.00

45 degree twist ... $8.00

Microwave Receiver, 3 CM. Sensitivity: 10-13 Watts. Complete with L.O. and AFC Mixer and Waveguide Input Circuits. 6 I.F. Stages give approximately 120 DB gain at a bandwidth of 1.7 MC. Video Bandwidth: 2 MC. Uses latest type AFC circuit. Complete with all tubes, including 723A/B Local Oscilator ... $175.00

POWER TRANSFORMERS

Comb. Transformers—115V/50-60 cps Input

CTJ5-2-600VCT/.2A, 5V/CA		$5.95
CT-15A	550VCT .085A 6.3V/.6A, 6.3V/1.8A	2.85
CT-164	4200V.002A/12KV Test, 5VCT/3A/12KV Test, 6.3V/0.6A/5400 V Test	12.95
CT-341	1050V/10MA,—625V @ 5 MA, 26V @ 4.5A 2x2.5V/3A, 6.3V @ 3A	16.95
CT-825	360VCT .340A 6.3VCT/3.6, 6.3VCT/3A	3.95
CT-626	1500V .160A 2.5/12, 30/.100	9.95
CT-071	110V .200A 33/.200, 5V/10, 2.5/10	4.95
CT-367	580VCT .050A 5VCT/3A	2.25
CT-99A	2x110VCT .010A 6.3/1A, 2.5VCT/7A.	3.25
CT-403	350VCT .026A 5V/3A	2.75
CT-931	585VCT .086A 5V/3A, 6.3V/6A	4.25
CT-610	1250 .002A 2.5V/2.1A, 2.5V/1.75A	4.95
CT-456	390VCT 80MA 6.3V/1,3A, 5V/3A	3.45
CT-160	800VCT 100MA 6.3V/1,2A, 5V/3A	4.95
CT-931	585VCT 86MA 5V/3A, 6.3V/6A	4.95
CT-442	525VCT 75MA 5V/2A, 10VCT/2A, 50V/200MA	3.85
CT-720	550-0-550V/250MA, 6.3V/1.8A	8.95
CT-43A	600-0-600V/.08A, 2.5VCT/6A, 6.3VCT/1A	6.49
CT7-501	650VCT/200MA, 6.3V/5A	6.49
CT-444	230-0-230V/.085A, 5V/3A, 6V/2.5A	3.49

Filament Transformers—115V/50-60 cps input

Item	Rating	Each
FT-674	8.1V/1.5A	$ 1.10
FT-157	4V/16A,2.5V/1.75A	2.95
FT-101	6V/.25A	.79
FT-924	5.25V/21A, 2x7.75V/6.5A	14.95
FT-824	2x26V/2.5A, 16V/1A, 7.2V/7A, 6.4V/10A, 6.4V/2A	8.95
FT-463	6.3VCT/1A, 5VCT/3A, 5VCT/3A	5.49
FT-55-2	7.2V/21.5A, 6.5V/6.85A, 5V/6A, 5V/3A	8.95
FT-986	16V @ 4.5A or 12V @ 4.5A	3.75
FT-38A	6.3/2.5A, 2x2.5V/7A	4.19
FT-A27	2.5V/2.5A, 7V/7A, TAP 2.5V/2.5A, 16KV TEST	18.95
FT-608	6.3V/3A/750V Test	1.79
FT-873	4.5V/.5A, 7V/7A	2.19
FT-899	2x5V @ 5A, 29KV Test	24.50

Plate Trans.—115V, 60 cps

Item	Rating	Price
PT-446	18.5V3.5A	$4.59
PT-699	300/150V/.05A, 300/150V/.05A	2.79
PT.302	120-0-120V/350MA	4.69
PT-671	62V/3.5A	7.95

Special Fil. Transformers—60 cps

Item	Pri. Volts	Secondaries	Price
STF-370	220/440	3x2.5V/5A, 3KV Test 2.5V/15A	$ 6.95
STF-11A	220V	2x40V/.05A, 2x5V/6A 12.6V/1A	4.49
STF-608	220V	24V/0.6A, 5V/3A, 6.3V/1A, 6.3V/1A	3.45
STF-968	230V	2.5V/6.5A	3.50
STF-631	230V	2x5V/27A, 2x5V/9A	17.59

THERMISTORS VARISTORS

D167018	$1.50
D167332	1.50
D167613	1.50
D166228	1.50
D164699	2.50
D163903	1.95
D166792	2.15

D171812	$1.50
D172155	1.50
D167176	1.50
D168687	1.50
D167208E, D171858	1.50
308A, 27-B	1.50
D168403	2.15

FILTER CHOKES

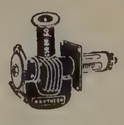
Stock	Description	Price
CH-366	20H/.3A	$ 6.95
CH-322	.35H/350 MA—10 Ohms DCR	2.75
CH-141	Dual 7H/75MA, 11H/60 MA 5KV DC Test	4.69
CH-119	8.5H/125 MA	2.79
CH-69-1	Dual: 120H/17 MA	2.35
CH-8-28	2 x .5H/380 MA/25 Ohms	1.79
	DCR, 1 KV TEST	2.95
CH-776	1.28H/130 MA 75 ohms	2.25
CH-344	1.5H/145MA/1200V Test	2.35
CH-43A	10HY/15MA—850 ohms DCR	1.75
CH-917	10H, 450MA, 10KV TEST	12.95
CH-366	20H/300MA	6.95
CH-999	15HY/15MA—400 ohms DCR	1.95
CH-511	6H/80MA—310 ohms DCH	2.45
CH3-501	2 x .5HY/400MA	2.79
CH-188M	5HY 200MA	1.79
CH-488	10HY .030A	1.19
CH-791	Dual 1.75-.125 HY 100 MA	1.27
CH-981	15 HY .110A	1.59
CH-22-1	1 HY .100A	1.17
CH-779	.6HY .490A	1.25
CH-25A	SW .09/.018 HY 3/.3A	8.95
CH-922	10000 HY 0 MA	2.75
CH-043	2.2 HY 80 MA	.98
CH-89A	2 x 1.52H @ .167A	1.39
CH-303	300H/.02A, 2500V Test	1.69
CH-932	SWING 9-60H/.4-.05A, 10KV	7.95
CH-445	0.5 HY/200 MA, 32.2 OHMS, 3000V.T.	1.39
CH-170	2X0.5H/380 MA, 25 OHMS	2.79
CH-533	13.5H, 1.0 AMP DC, 13.5KV INS.	39.95

MAGNETRONS

Tube
2J27
2J31
2J21
2J22
2J26
2J32
2J38
2J39

Tube
2J49
2J56
2J61
700
706
2J62
3J31
5J30

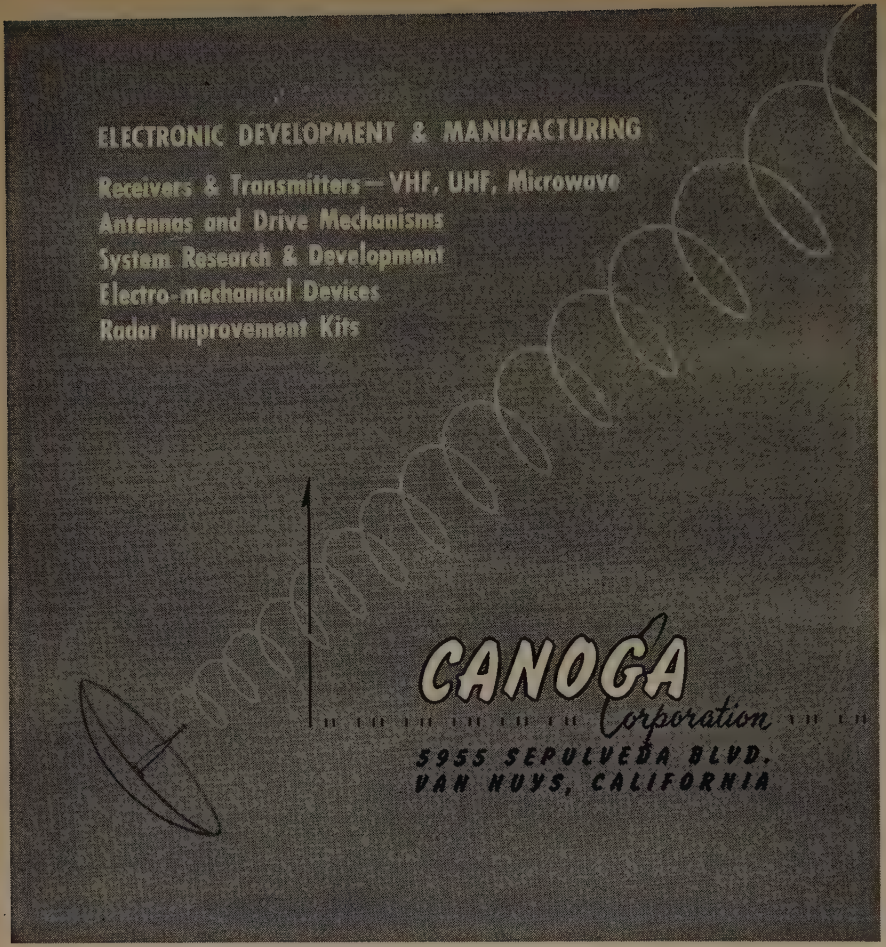
Tube
718DY
720BY
725-A
730-A
QK 62
QK 61
QK 60



MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D. RATED CONCERNS SEND P.O. ALL MDSE. SUBJECT TO PRIOR SALE, AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.

PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK OR RAILEX.

131 Liberty St., New York 7, N. Y. Dept I-4 Chas. Rosen Phone: Digby 9-4124


ELECTRONIC DEVELOPMENT & MANUFACTURING

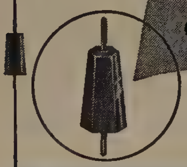
Receivers & Transmitters—VHF, UHF, Microwave
Antennas and Drive Mechanisms
System Research & Development
Electro-mechanical Devices
Radar Improvement Kits

CANOGA Corporation
5955 SEPULVEDA BLVD.
VAN NUYS, CALIFORNIA

To meet the strictest requirements of both Government and Industry, specify

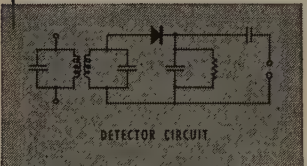
JAN TYPE

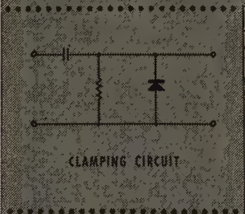
RR Germanium Diodes

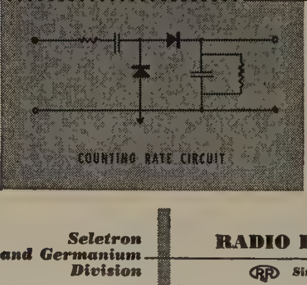


Precision made, easy to handle, easy to assemble—the tapered shape shows polarity at a glance! Make **Radio Receptor** Germanium Diodes your first choice in the large variety of electronic circuits where JAN types are a must.

1N69
1N70
1N81


DETECTOR CIRCUIT


CLAMPING CIRCUIT


COUNTING RATE CIRCUIT

TYPICAL USES

COMPUTOR CIRCUITS
CLAMPING CIRCUITS
RF DETECTORS
CONTROL CIRCUITS
DISCRIMINATORS
MODULATORS
NOISE ELIMINATORS
CLIPPERS
LEVEL SETTERS
RESTORER CIRCUITS

JAN TYPES • ALL VALUES MEASURED AT 25°C.

CODE NO.	Min. Forward Current at 1 Volt (MA)	Max. Reverse Current (Micro-Amperes)	*Average Rectified Current (MA Max.)	†Minimum Reverse Volts	Max. Cont. Reverse Operating Volts
1N69	5.0	50 @ −10V 850 @ −50V	40	75	60
Rectification efficiency: 35% minimum in 100 MC test circuit.					
1N70	3.0	25 @ −10V 300 @ −50V	30	125	100
1N81	3.0	10 @ −10V	30	50	40

*Average half wave rectified current at 60 CPS and 25°C. Consult us for ratings at other conditions.
†For zero dynamic resistance.

Radio Receptor Germanium Diodes may hold the answer to many of your problems. Our engineers will be glad to study your requirements and submit their recommendations. Many other types, both standard and special, are available . . . Write us!

Seletron
and Germanium
Division

RADIO RECEPTOR COMPANY, INC.
RR *Since 1922 in Radio and Electronics* RR
SALES DEPT: 251 West 19th Street, New York 11, N. Y. • FACTORY: 84 North 9th Street, Brooklyn 11, N. Y.

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 156A)

rating for inductive and heater load is 125 or 250 volts, 10 amperes. Curren ratings are based on a maximum permissible temperature rise of 65°C. Inductive load ratings were determined by using AN3179 inductors.

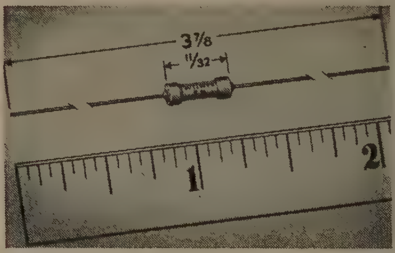
Other variations of the 7AS71 assembly are available in from three to eight gang assemblies of "V3" type single-pole double-throw basic switches and from two to eight switching positions at 45° angular rotation between positions.

Applications of the new series, in addition to lighting control, include aircraft landing gear indicators, X-ray and electronic equipment and aircraft electric windshield wipers.

Deposit Carbon Resistors

Rockbar Corp., 209 E. 37 St., New York 17, N. Y., manufacturers' representative, announces a completely new line of Welwyn high stability deposit carbon resistors.

The resistors include a subminiature series available in a range from 10 ohms to 1 megohm, with dimensions measuring ⅛-inch diameter by 15/32-inch long. Supplied in tolerances of 1, 2, and 5 per cent these resistors lend themselves to precision applications where current flow is small These miniature resistors are rated at ⅛-watt, under which conditions the temperature rise does not exceed 40° over ambient They also may be safely used at ¼-watt ratings where a temperature increase of 100° is permissible.



These and all other Welwyn high stability resistors are constructed to insure permanent contact between pigtail terminals and resistor element. They are made of crystalline carbon deposit on porcelain rods to which machined end-caps are firmly attached, and into which the tinned-copper terminal wires are staked and then soldered for double protection.

Ceramic Microphone

The Century microphone produced by **Electro-Voice, Inc.,** Buchanan, Mich., is now available in the "Ceramic" Model 715.

The Model 715, with all the features of the Century, has a moisture-proof ceramic generating element and unusually high output (−55 db.). Assures dependable and

(Continued on page 159A)

News—New Products

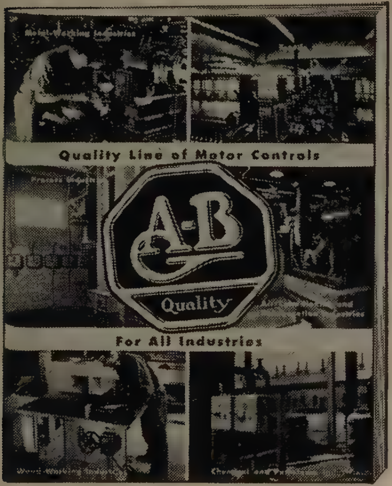
These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 158A)

long-lasting service in extremely hot, humid climates. Essentially non-directional, becoming directive at higher frequencies. Can be used in any position in hand, on table, on stand or overhead. It is ac-dc insulated, and has high impedance. Pressure cast case is finished Satin Chromium. Has 5 foot cable. Size 3 inches×2$\frac{3}{16}$ inches×1 inch. Weighs only 6 ounces. List price is $11.25.

Motor Controls Bulletin

The Allen-Bradley Co., 114 W. Greenfield Ave., Milwaukee 11, Wis., has released a new 28-page bulletin, "Quality Line of Motor Controls for All Industries."



In this Bulletin the most important items in Allen-Bradley's line of standard motor control apparatus have been outlined. Controls, starters, and accessories are described and their applications listed.

A special feature of the Bulletin is the section illustrating glimpses behind the scenes of the Allen-Bradley Company.

Requests for this Bulletin, submitted on company letterhead, will receive prompt attention.

Carbon Mobile Microphone

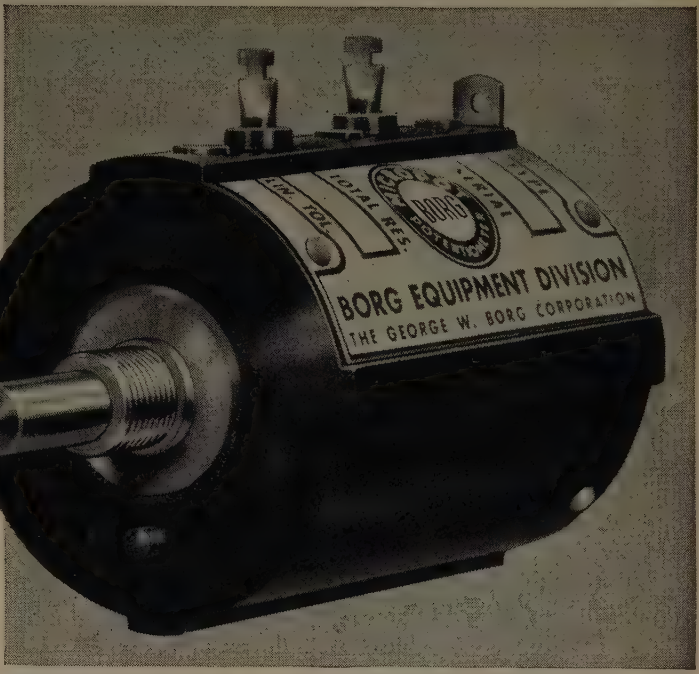
A new Model 208 hand-held differential type noise cancelling, high output, single-button carbon microphone is now being produced by **Electro-Voice, Inc.**, Buchanan, Mich.

Unusually small in size, the Model 208 is designed for convenient close-talking and maximum intelligibility in mobile communications and similar applications. Articulation is at least 97 per cent under quiet conditions, 88 per cent under 115 db of ambient noise.

Frequency response: to sounds of close origin, substantially flat 100 to 4,000 cps. Output: −50 db. Temperature Range: from −40° to 185°F. Blast proof, water

(Continued on page 160A)

THE HIGH-PRECISION LINEAR POTENTIOMETER

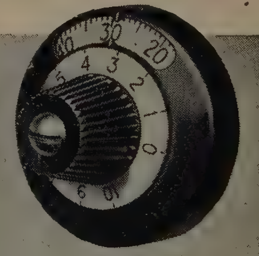


MICROPOT
precision ten-turn potentiometer

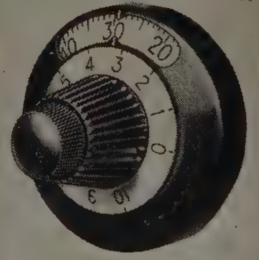
BORG MICROPOT TEN-TURN POTENTIOMETER: Built to fit the specifications of control system engineers and designers . . . constructed with Micro accuracy for precise voltage adjustments . . . featuring an assembly scientifically designed, machined, assembled and automatically machine tested for linearity of ±0.1% and 0.05%, zero-based. MICROPOTS ARE AVAILABLE IN 1.15 to 3 OHM and 30 to 250,000 OHM RANGES FOR IMMEDIATE SHIPMENT.

BORG MICRODIAL: Two concentrically mounted dials: one for counting increments of each turn and the other for counting turns . . . delivered completely assembled with dials synchronized. Outstanding features include smooth, uniform action . . . no backlash between incremental dial and potentiometer contact . . . less wear, only one moving part aside from the two dials . . . contact position indicated to an indexed accuracy of 1 part in 1,000.

MICROPOT-MICRODIAL CATALOG SENT PROMPTLY ON REQUEST



BORG MICRODIAL 746-A
A precision ten-turn indicating dial assembly. Has screw locking device on operating knob.



BORG MICRODIAL 746-B
Same as 746-A but has knurled locking screw mounted externally to operating knob.

BORG EQUIPMENT DIVISION
THE GEORGE W. BORG CORPORATION
Janesville • Wisconsin

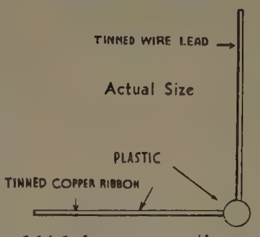
THEY DON'T FAIL!

FOR ACCURACY—ADAPTABILITY—DEPENDABILITY

USE TRANSISTOR PRODUCTS

- **Gold Bonded Germanium Diodes**

These extremely small plastic-encased germanium diodes offer a great many advantages for a multitude of applications. Excellent for low level use, they also have unusually high conductivity at high levels. Noise characteristics are excellent, and high frequency rectification characteristics are vastly superior to conventional types. Requests for information and samples of diodes functioning as frequency multipliers, second detectors, mixers and DC restorers are cordially invited.



- **Germanium Transistors**

Designed to perform many of the functions of vacuum tubes as well as opening frontiers for new apparatus in the field of electronics, TRANSISTOR PRODUCTS point contact transistors may be used for power amplifiers, oscillators, and switches. Five "feeler" types are available in quantity. You are invited to submit your own specifications.

- **TRANSISTOR PRODUCTS' TRANSISTOR TEST SET**

This device is designed to test the signal behavior of all transistors, and can be used most advantageously by circuit engineers and transistor maufacturers. Comparable to a vacuum tube bridge in that field, it is not, however, a null instrument. Its design insures continued usefuless as new transistors are developed.

Write to TRANSISTOR PRODUCTS now for additional information

TRANSISTOR PRODUCTS is an operating unit of the Clevite Corp.

TRANSISTOR PRODUCTS, inc.
Snow and Union Sts., (Brighton Sta.) Boston 35, Mass.

RREP has been the prime developer, designer, and producer of precision electronic telemeter equipment since the industry's infancy back in 1942 . . .

RREP TELEMETRY systems are presently used by U.S. military agencies, many foreign governments, most major aircraft companies, and numerous research and industrial organizations . . . This invaluable experience puts no premium on the cost of RREP equipment. Naturally, we will discuss your plans in complete confidence.

RREP

RAYMOND ROSEN ENGINEERING PRODUCTS, Inc.
32nd & Walnut Streets • Philadelphia 4, Pa.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 159A)

proof, shock resistant. Press-to-talk switch actuates button and relay simultaneously. Input, standard single button. Supplied with 5 foot three-conductor cable. Size $2\frac{1}{4}$ inches$\times 1\frac{1}{2}$ inches$\times 1\frac{1}{8}$ inches. Net weight 3 ounces. List price, $16.50.

Tantalum Capacitors

Bulletin 6.100, just released, **Fanstee Metallurgical Corp.,** North Chicago, Ill. lists and describes a line of tantalum electrolytic capacitors ranging from 1.5 to 30 μf, with working voltages up to 125 volts dc.

These capacitors, intended for applications where unusually stable characteristics are required and space is at a premium employ porous tantalum anodes. The normal temperature range at rated working voltage is from 55°C and +85°C. Excluding connection leads, the capacitor occupies less than 1/10 of a cubic inch.

The bulletin lists 22 standard capacitors, all of which are in commercial production. The bulletin also contains a page o curves showing capacity and equivalen series resistance in relation to temperatur and frequency.

Although tantalum capacitors of thi type have been in production since October, 1949, it is only recently that plan facilities have been expanded so that the are now generally available.

Copies of Bulletin 6.100 may be obtained from the manufacturer.

X-Band ATR

Microwave Associates, Inc., 22 Cummington St., Boston 15, Mass., has a new type 6976 ATR, designed for operatio in the X-Band at a frequency of 9280 mc It is electrically but not mechanically interchangeable with such types as th 1B35 and 1B35A. It features a brai gasket flange type of mounting locate near the window instead of a resonan choke mounted seat. Because of this, lowe values of normalized equivalent conductance and freedom from arcing at hig power operation are achieved. The tube i

(Continued on page 161A)

hese manufacturers have invited PROCEEDINGS eaders to write for literature and further technical nformation. Please mention your I.R.E. affiliation.

(Continued from page 160A)

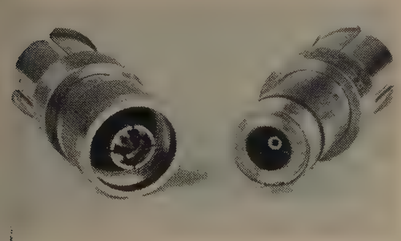
completely silver brazed resulting in extreme electrical and mechanical uniform- ty. It is small and compact in design, having an overall length of one inch. The tubulation is located on the narrow side of the waveguide body, thus providing greater clearance for associated equipment.

The mount for the 6276 is of the flange contacting type and may be procured from Airtron, Inc. under part number 47855.

The electrical equivalent of the type 1B37 is also available. This tube, the 6284, is mechanically interchangeable with the type 6276 and may be used in the same mount. It is designed for operation at frequency of 8750 mc.

Coaxial Adaptors and Accessories

General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass., now has adaptors to connect from Type 874 coaxial connectors to either male or female of Types N, C, BNC, or uhf high-frequency connectors. The adaptors have excellent electrical characteristics with a low vswr even at several thousand mc. These adaptors not only make it possible to utilize the advantages of the Type 874 line when measurements are made on equipment fitted with military-type connectors, but also make it simple to interconnect systems using any of the various connectors.

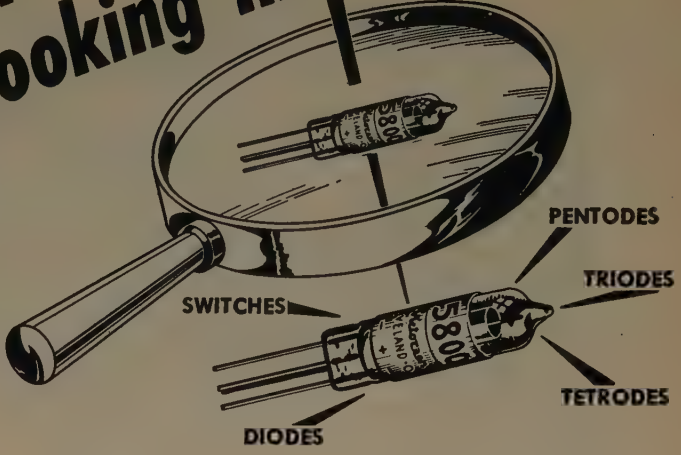


A new adjustable line is also announced for use in measurement work requiring a section of coaxial line of adjustable length but with uniform impedance. The Type 874-LK is a 50-ohm line adjustable from 58 to 80 centimeters. It has a vswr of less than 1.10 at 2,000 mc.

A shielded component mount has also been added to the GR Type 874 line of coaxial elements to facilitate the accurate measurement of resistors, capacitors, and inductors.

(Continued on page 163A)

Worth Looking Into...



Electrometer Tubes...

Subminiature in size only—Victoreen electrometer tubes do a big job in reliable measurement of electrostatic potentials and extremely small currents.

Every day brings increased use of electrometer tubes in electrostatic voltmeters, computers, spectrographs, ph. meters, photometers, ion chamber instruments—wherever only 10 mil filament drain, extremely low grid currents, high inter-electrode resistance and stable D.C. characteristics are important.

LOOK into this new factual catalog for complete specifications, illustrations, typical circuits for electrometer tubes and other Victoreen components.

Send for catalog 3016

BETTER COMPONENTS MAKE BETTER INSTRUMENTS

The Victoreen Instrument Co.

3800 PERKINS AVE. • CLEVELAND 14, OHIO

"Wow-Meter"

New Improved Model 115-RA

Improved direct-reading instrument simplifies measurements of wow and flutter in speed of phonograph turntables, wire and tape recorders, motion picture projectors and similar recording or reproducing mechanisms. It is the only meter in existence providing direct, steady indication of meter pointer on scale.

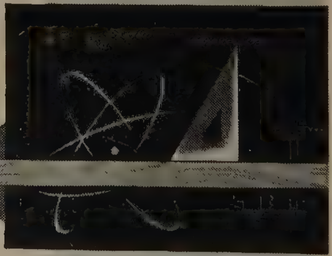
The Furst Model 115-RA with improved stability is suitable for both laboratory and production application and eliminates complex test set-ups.

A switch on the front panel permits selection of low frequency cut-off and corresponding meter damping for use on slow speed turntables.

Frequency Response: ½ to 120 cycles or 10 to 120 cycles
Sensitivity: 0.2, 0.5, and 2.0% Wow Full Scale
Inquiries invited on our line of Regulated Power Supplies

FURST ELECTRONICS
3326 W. Lawrence Ave., Chicago 25, Illinois

"Back home in Indiana"



I.D.E.A., Inc., is looking for a design engineer. Someone who would like to make Indianapolis his permanent home—who would like to work for a young, forward looking company that is already the leader in its field. If you are that man, address full information about yourself to: R. A. Morris, Chief Engineer, I.D.E.A., Inc., 7900 Pendleton Pike, Indianapolis 26.

Makers of the Regency VHF Booster, UHF Converter and other electronic devices.

Regency

INDIANAPOLIS, INDIANA

Thank You!

IRE

is grateful to the tens of thousands of engineers who have attended the 1953 Radio Engineering Show.

The 407 exhibitors who have cooperated with the Institute of Radio Engineers have truly provided a "Preview of Progress" of the radio-electronic industry. Their exhibits follow the path of the electron into every industry. Exhibitors are presenting radio and television of tomorrow both in the component and the apparatus, which will make the new electronic age.

Certainly the engineers in our industry have provided in these exhibits an informative report on their progress. The hours spent visiting the show should yield a rich reward in information.

For March 22-25, 1954 KINGSBRIDGE IS A SOLUTION

While the Grand Central Palace has been three things to us, grand, central, and definitely a palace, nevertheless its limits have been reached and this year 106 manufacturers in our industry were unable to show their products. Obviously, New York's largest exhibition hall has become too small for the enormous electronic industry! The Kingsbridge Armory provides a solution to those static elements of Grand Central Palace which hampered growing firms from having larger exhibits. The fact that so many firms have been unable to exhibit this year means that many new firms anxious to show new products and some excellent established companies who have built big electronic departments have been frozen out of exhibiting due to lack of space. The Kingsbridge Armory will relieve this situation, at least until the Coliseum is built.

Kingsbridge offers us 86,000 square feet of actual exhibit space in 796 booth units. This represents a gain of 35% in exhibit space over the usable total in Grand Central Palace. At Kingsbridge everything is on one floor, which gives us the most democratic type of exhibition.

Because this building is the largest in America under a single suspension roof and the area is completely free of pillars, the standard 10′ x 10′ exhibit unit offers exhibitors maximum economy. Moreover, there are no high walls which require draping. We confidentially believe that we can run a more satisfactory show than ever before.

A system of high-speed, private, express buses from the Waldorf-Astoria Hotel area to Kingsbridge, and the two excellent lecture halls right in the building, seating 720 and 960 people respectively, will make Kingsbridge a genuine solution to our problems.

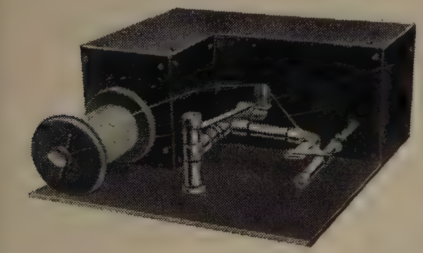
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 161A)

Coil Winder

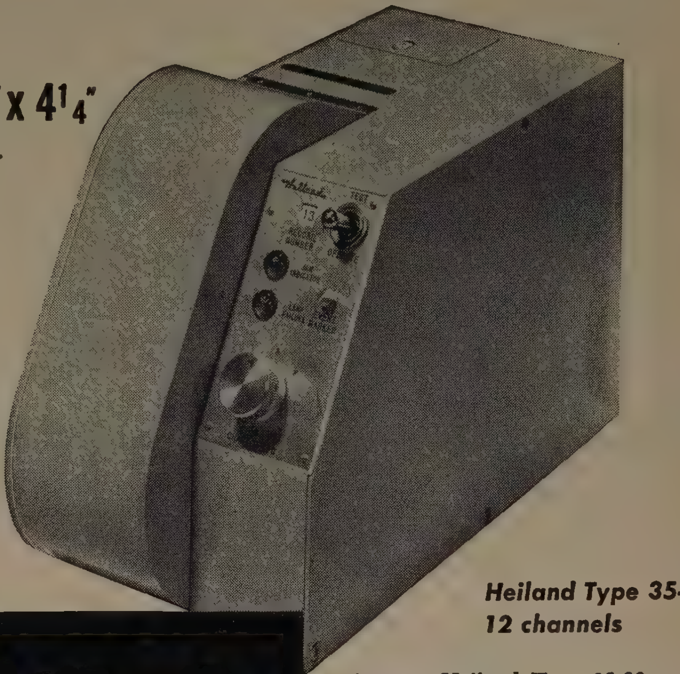
Alcar, Inc., 2 Godwin Avenue, Fair Lawn, N. J., has a new coil winder Model 101, an efficient, compact instrument for winding precision universal coils. Setting coils of as much as four inches diameter may be wound. The instrument comes complete with motor, wire foot, spool rack and tension control. It is a self-contained unit in its own storage case with no extras to buy or loose parts to change.



Directions are included to wind experimental cross-over coils.

Our engineering department is available for consultation. Price F.O.B. Fair Lawn $200.00.

(Continued on page 165A)



First Showing...

New Miniature... **OSCILLOGRAPH RECORDER**

10 1/8" x 6" x 4 1/4"
Weight 15 lbs.

Heiland

Heiland Type 35-50
12 channels

The new Heiland Type 35-50, using 35mm. or 50mm. paper or film, has been designed and developed to meet an increasing demand by engineers and scientists for a small, lightweight recorder with accuracy of amplitudes and timing. All the features generally found only in much larger recorders are incorporated in the new, versatile and rugged Type 35-50.

Features...

- **Remote speed control... 8 recording speeds**
- **Up to 12 galvanometers... electromagnetically or fluid damped**
- **Complete "no record" warning system**
- **Integrated magazine... capacity 100′ of 35mm. or 50mm. film or paper**
- **Precision electronic timing**
- **Event marker**
- **Trace identifier**
- **Visual monitoring**
- **Record numbering**
- **Film or paper footage indicator**
- **All Operating Controls on one surface**

● The new Heiland bridge balance and strain indicator. ● The new Heiland solid-frame galvanometers. ● The versatile Heiland 708B recorder... up to 24 channels ...for rack or table mounting.

write or wire for a complete catalog of Heiland instruments.

The Heiland Research Corporation 130 EAST FIFTH AVENUE
DENVER, COLORADO

PROFESSIONAL CARDS

ALFRED W. BARBER LABORATORIES

Specializing in the Communications Field and in Laboratory Equipment
Offices, Laboratory and Model Shop at:
32-44 Francis Lewis Blvd., Flushing, L.I., N.Y.
Telephone: Independence 3-3306

CROSBY LABORATORIES, INC.

MURRAY G. CROSBY & STAFF
RADIO-ELECTRONIC RESEARCH
DEVELOPMENT & MANUFACTURING
COMMUNICATIONS, FM & TV
ROBBINS LANE
HICKSVILLE, NEW YORK
HICKSVILLE 3-3191

ELDICO OF NEW YORK, INC.

Donald J. S. Merten and Engineering Staff
Consultants on Interference Elimination from Transmitters, Induction Heaters, Diathermy, etc.
44-31 Douglaston Parkway, Douglaston, L.I., N.Y.
Bayside 9-8686

Richard B. Schulz

Electro-Search

Radio-Interfeernce Reduction;
Development of
Interference-Free Equipment,
Filters, Shielded Rooms
4337 N. 5th Street, Philadelphia 40, Pa.
GLadstone 5-5353

ELK ELECTRONIC LABORATORIES, INC.

Jack Rosenbaum
Specializing in design and development of Test Equipment for the communications radar and allied fields
333 West 52nd St., New York 19, PL-7-0520

F-R MACHINE WORKS INC.

ELECTRONICS & X-RAY DIVISION
DESIGN - DEVELOPMENT - MANUFACTURE
44-14 Astoria Boulevard Long Island City 3, N.Y.
Phone AStoria 8-2800

HARRIS GALLAY

Electronic Consultant
Military Electronics Since 1935
Your inquiries solicited and our experience is at your command.
60 Perry Street Belleville 9, N.J.
Plymouth 9-4237

PAUL GODLEY CO.

Consulting Radio Engineers
P.O. Box J, Upper Montclair, N.J.
Offs & Lab.: Great Notch, N.J.
Phone: Montclair 3-3000
Established 1926

HIGHLAND ENGINEERING CO.

William R. Spittal & Staff
Design, Development and Manufacture of Transformers, Chokes, Etc.
for the
Electronic, Industrial and Allied Fields
Main & Urban, Westbury, L.I., N.Y.
WE-7-2933

HOGAN LABORATORIES, INC.

John V. L. Hogan, Pres.
APPLIED RESEARCH, DEVELOPMENT, ENGINEERING
Est. 1929. Electronics, Optics, Mechanisms, Facsimile Communication, Digital Computers, Electro-sensitive recording media, Instrumentation.
155 Perry Street, New York 14 CHelsea 2-7855

LEONARD R. KAHN

Consultant in Communications and Electronics
Single-Sideband and Frequency-Shift Systems
Diversity Reception - Modulation Theory
Applications of Magnetic Tape Recording
Elizabeth Bldg., 22 Pine St., Freeport, L.I., N.Y.
Freeport 9-8800

DAVID C. KALBFELL, Ph.D.

KAY-LAB Electronic Instruments
Laboratory and Manufacturing Facilities
Specializing in Electronic
Instrumental and Industrial Problems
1090 Morena Blvd. Woodcrest 6359
San Diego 10, California

MEASUREMENTS CORP.

RESEARCH & MANUFACTURING ENGINEERS
Harry W. Houck Jerry B. Minter
John M. van Beuren
Specialists in the Design and Development of Electronic Test Instruments
BOONTON, N.J.

L. J. CASTRIOTA M. WIND
S. W. ROSENTHAL P. G. MARIOTTI

Microwave Consultants

Radio Frequency and Microwave Components
Telephone G.P.O. Box 844
BOulevard 3-2096 Brooklyn 1, N.Y.

MICROWAVE SERVICES, INC.

"Architects of Modern Communications"
CONSULTANTS, ENGINEERS, CONSTRUCTORS
Wire, Carrier, Radio—Inside and Outside Plant Facilities
S. K. Wolf, E. Labin, V. J. Nexon, and Associates
45 Rockefeller Plaza, New York 20 Circle 7-4953

A. NEWTON

Circuit analysis, design and development in the fields of VHF, UHF tuners, TV receivers and accessories, laboratory and test instrumentation.
105-20 66th Ave., Forest Hills, N.Y.
TW 7-9429

PICKARD AND BURNS, INC.

Consulting Electronic Engineers
Analysis and Evaluation of Radio Systems
Research, Development, Design and Production of Special Electronic Equipment and Antennas.
240 Highland Ave. Needham 94, Mass.

PSC APPLIED RESEARCH LTD.

Development & Production
AIRCRAFT and INDUSTRIAL
INSTRUMENTS • AIDS • SYSTEMS
Navigation - Survey - Processing - Servo
Gyro - Photo - Magnetic - Electronic
Radiation - Optical
J. M. Bridgman, General Manager
1450 O'Connor Drive Toronto, Canada

PAUL ROSENBERG ASSOCIATES

Consulting Physicists
100 STEVENS AVE. • MOUNT VERNON, NEW YORK
CABLE: PHYSICIST MOunt vernon 7-8040

TELECHROME, INC.

Electronic Design Specialists
COLOR TELEVISION EQUIPMENT
Flying Spot Scanners, Color Synthesizers, Keyers, Monitors, Oscilloscopes and Related Apparatus
J. R. Popkin-Clurman, Pres. & Ch. Engr.
88 Merrick Rd. Amityville, L.I., N.Y.

TELREX, INC.

M. D. Ercolino, Pres.
H. F. ANTENNA SPECIALISTS
Communication Arrays
Reception or Transmission
For FM, TV, and Amateur Service.
Asbury Park, N.J.—Phone AP 2-7252

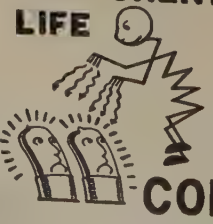
WHEELER LABORATORIES, INC.

Radio and Electronics
Consulting — Research — Development
R-F Circuits — Lines — Antennas
Microwave Components — Test Equipment
Harold A. Wheeler and Engineering Staff
Great Neck, N.Y. Great Neck 2-7806

WIHTOL LABORATORIES

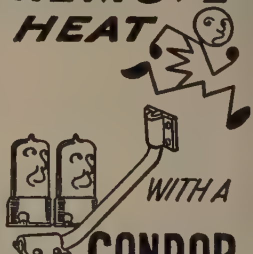
Consulting — Research — Development — Electron Tubes — Vacuum and Gas Tube Manufacturing Techniques — Glass Techniques — Special Purpose Tubes.
W. Wihtol, Director
2333 Grey, Evanston, Illinois
University 4-7896

HEAT REDUCES COMPONENT LIFE



PERMANENT, TROUBLE-FREE
EASY TO INSTALL
FINE FOR POTTED UNITS
STOCK UNITS 6, 9 & 12 INCHES
3/16" DIA. 10 WATTS
1/4" DIA. 20 WATTS
3/8" DIA. 50 WATTS
SAMPLE $5 - CIRCULAR FREE

REMOVE HEAT



WITH A **CONDOR COOLER**
PAT. APPLIED FOR

CONDOR RADIO MFG. CO.
2705 S. KRAMER TUCSON, ARIZ.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 163A)

Magnetic Heads

The first two units of the new line of magnetic heads are now in production at the **Brush Development Co.,** 3405 Perkins Ave., Cleveland 14, Ohio. One is a record /reproduce head, BK-1090; the other, its erase head companion, is a BK-1110. The BK-1090 is intended for dual track recording, and distinguishes itself by very high resolution and uniformity. The most outstanding feature of the BK-1110 is its low power consumption of less than ½ volt amperes.

These units are cast into a block of specially selected synthetic resin which makes them extremely uniform, moisture proof, nonmicrophonic, and allows operation throughout a wide temperature range. The low loss core structure is made from thin molybdenum permalloy laminations carefully annealed and cemented together to permit the use of high bias and erase frequencies. These components are enclosed in a mu metal shield to provide optimum shielding from extraneous magnetic fields. Shape of the head permits close mounting of adjacent heads and provides correct approach angle of the tape.

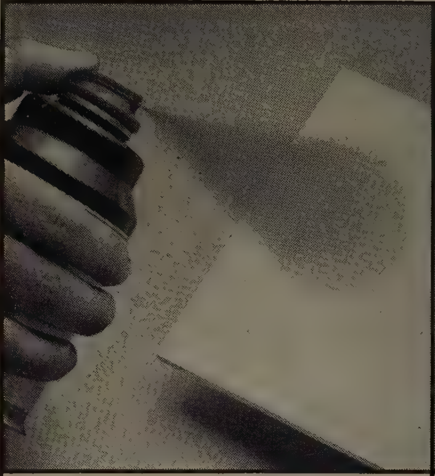
Four Watt Resistor

A new power resistor, type PW4 rated at four watts, has been developed by **International Resistance Co.,** 401 N Broad St., Philadelphia 8, Pa.

Completely insulated with an inorganic core material molded in a high temperature plastic, this unit will not support combustion. Wire element is uniformly and tightly wound on glass fibre core with axial leads 1½ inches long; 0.036 inch diameter. Body dimensions: 1¾ inches long by 21/64 inch diameter. Type PW4 available from 1 ohm to 8200 ohms in ±5 per cent and ±10 per cent tolerance. This four watt resistor is suited for television circuits requiring 2 to 3 watts actual dissipation at high ambient temperature, resistance element of resistance capacitance filter in automobile receiving sets where operation is at high ambient temperature, and all other circuits where a stable resistor is required, with wattage dissipation of 4 watts and less.

It pays to **check TEFLON***

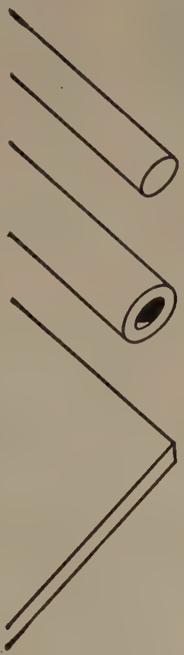
for non-porosity



Penetrating dye applied on cleaned Teflon part will penetrate wherever porosity exists.

Magnified section of porous Teflon part, even when wiped clean, shows telltale dye stains. You'll find no such dye penetration in Fluoroflex-T products.

Assure dielectric stability in parts by using non-porous **FLUOROFLEX®-T**



Porosity detracts from any insulating material—even from a virtually perfect UHF dielectric such as Teflon. How can you tell whether Teflon has porosity? By a penetrating colored dye test. Clean the part, apply dye, wipe off. When magnified, absorbed spots of dye can be plainly seen.

Put Fluoroflex-T products to the test and you won't find any penetration in either rod, tube, or sheet. For two reasons: (1) Teflon powder is extruded or molded on equipment especially designed to compact it to the critical density. This not only prevents porosity but also provides highest tensile strength. (2) Normal discolorations in Teflon are left unbleached to retain this optimum density.

That's why you can always count on Fluoroflex-T for electrical stability in severest use. Stress-relieved, it is also dimensionally stable and machines properly with minimum rejects. Write for Bulletin FT-19.

**DuPont trade mark for its tetrafluoroethylene resin.*
® Resistoflex trade mark for products from fluorocarbon resins.

RESISTOFLEX
corporation
Belleville 9, N. J.

SPECIALLY ENGINEERED FLEXIBLE RESISTANT PRODUCTS FOR INDUSTRY

INDEX AND DISPLAY ADVERTISERS

Meetings with Exhibits 2A
News and New Products 30A
Industrial Engineering Notes 66A
Section Meetings 81A
Student Branch Meetings 86A
Membership 93A
Positions Open 126A
Positions Wanted by Armed Forces Veterans 134A

A'G'A (Div. Elastic Stop Nut Corp.) . . .122A
Ace Engineering & Machine Co. 87A
Acme Electric Corp. 90A
Aerovox Corp. 50A
Airborne Instr. Laboratory, Inc. 154A
Aircraft Armaments, Inc. 138A
Airtron, Inc. 98A
Alden Products Corp. . . . . .42A & 43A
Allen-Bradley Co. 58A
Allied Radio Corp. 45A
American Electric Motors 54A
American Lava Corp. 23A
American Phenolic Corp. . . . . .80A & 81A
American Television & Radio Co. 55A
Amperite Company, Inc. 120A
Ampex Electric Corp. 59A
Andrew Corp. 106A
Arnold Engineering Co. 6A
Associated Specialties Co. 146A

Ballantine Laboratories, Inc. 119A
Barber Laboratories, Alfred W. 164A
Barker & Williamson, Inc. 117A
Barry Corp., The 94A
Bell Telephone Labs. 4A
Bendix Aviation Corp. (Eclipse-Pioneer) .125A
Bendix Aviation Corp. (Radio Div.) 130A
Bendix Aviation Corp. (York Div.) 132A
Berkeley Scientific 56A
Birtcher Corp. 150A
Blaw-Knox Co. 61A
Bodnar Industries, Inc. 166A
Boeing Airplane Co. 133A
Borg Corp., George W. 159A
Brown Electro-Measurement Corp. 100A
Brush Electronics Co. (Magnetic Equip.) .53A
Bullova Watch Co. 52A
Bussmann Mfg. Co. 95A

Cambridge Thermionic Corp. 14A
Cannon Electric Co. 44A
Canoga Corp. 158A
Capehart-Farnsworth Corp. 130A
Cargo Packers, Inc. 115A
Carter Motor Co. 152A
Cascade Research 9A
Centralab (Div. of Globe Union) 51A
Chicago Telephone Supply Corp. 112A & 113A
Clare, C. P. & Co. 47A
Clarostat Mfg. Co., Inc. 75A
Cleveland Container Co., The 89A
Cohn Corp., Sigmund 108A
Collins Radio Co. 79A
Communication Products Co., Inc. .70A & 71A
Communications Equipment Co. 157A
Condor Radio Mfg. Co. 164A
Cons. Vultee Aircraft (Convair) 143A
Cornell Aeronautical Laboratory, Inc. . . .132A
Cornell-Dubilier Electric Corp. . . . . . .Cov. III
Corning Glass Works 99A
Crosby Laboratories, Inc. 164A
Crucible Steel Co. of America 33A

DX Radio Products, Inc. 122A
Dalis, Inc., H. L. 111A
Daven Co. 31A
De-Jur Amsco Corp. (Industrial) 156A
Delco Radio (Div. Gen. Motors Corp.) . .136A
Dialight Corp. 82A
Douglas Aircraft Co. 134A
Douglas Microwave Co., Inc. 147A
DuMont Labs., Allen B. 125A

Eitel-McCullough, Inc. 12A
Eldico of New York, Inc. 164A
Electrical Industries 77A
Electrical & Physical Instr. Corp. 114A
Electro Motive Mfg. Co., Inc. 5A
Electro-Search 164A
Electronic Engineering Co. of Calif. 130A
Electronic Research Assoc. 110A
Electronic Transformer Co. 62A
Electronic Tube Corp. 72A
Elk Electronic Laboratories, Inc. 164A
Engineering Associates 166A
Engineering Research Assoc., Inc. 140A
Erie Resistor Corp. 25A

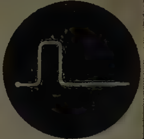
F-R Machine Works 164A
Fairchild Camera & Instr. Corp. 24A
Fairchild Eng. & Airplane Corp. (Guided Missile) .88A
Fansteel Metallurgical Corp. 78A
Fast & Co., John E. 116A
Federal Telephone & Radio Corp. 96A
Federated Semi-Conductor Co. 167A
Ferranti Electric, Inc. 56A
Ford Instrument Co. 118A
Frequency Standards 155A
Fugle-Miller Laboratories 118A
Furst Electronics 162A

Gallay, Harris 164A
General Ceramics & Steatite Corp. 7A
General Electric Co. (Apparatus) 73A
General Electric Co. (Empl.) 129A
General Electric Co. (Germanium Diode) .29A
General Electric Co. (I & T Tubes) 63A

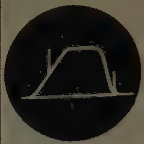
NEED INSTRUMENTS TO SOLVE ELECTRONIC PROBLEMS?...

RADA-SWEEP
Radar IF Amplifier Alignment

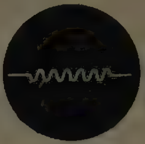
MEGA-MATCH
Measurement of Reflection Coefficient



MEGA-PULSER
Transient Testing Video Amplifiers



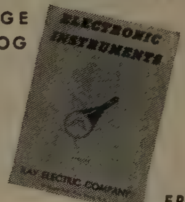
MARKA-SWEEP RF-P
TV Tuner Alignment



RADA-PULSER
Radar IF Transient Testing

CALIBRATED MEGA-SWEEP
Wide Range Sweeping Oscillator
Single Dial Tuned

CONSULT THIS LATEST 64-PAGE CATALOG



Write FREE

KAY ELECTRIC CO.
4 MAPLE AVE. PINE BROOK, N. J.

AN/APR-4 LABORATORY RECEIVERS

Complete with all five Tuning Units, covering the range 38 to 4,000 Mc.; wideband discone and other antennas, wavetraps, mobile accessories, 100 page technical manual, etc. Versatile, accurate, compact—the aristocrat of lab receivers in this range. Write for data sheet and quotations.

We have a large variety of other hard-to-get equipment, including microwave, aircraft, communications, radar; and laboratory electronics of all kinds. Quality standards maintained. Get our quotations!

We will buy any Electronic Material at top prices. SCHOOLS—unload your dusty surplus for cash or credit.

ENGINEERING ASSOCIATES
434 PATTERSON ROAD DAYTON 9, OHIO

There is Always One Leader in Every Field

BODNAR INDUSTRIES, Inc.

leads in the field of

TRANSILLUMINATED PLASTIC LIGHTING PLATES

BECAUSE OF *Quality* • *Uniformity* • *Performance*
Design & Layout "Know-How Service"
Quantity Production Promptly

NEW YORK —19 Railroad Ave., New Rochelle (Home Office)
TEXAS —Jefferson Tower Building, Dallas
CALIFORNIA—11056 Cumpston St., N. Hollywood
CANADA —313 Montreal Trust Bldg., 67 Yonge St., Toronto

SPECIMEN PANEL MIL-P-7788 (AN-P-89) SENT ON LETTERHEAD REQUEST

30,000

Radio-Electronic Engineers will receive and use the 1953 IRE DIRECTORY

The 1953 IRE DIRECTORY is—

Better and Better and Better!

More Engineers Listed than ever before! IRE membership continues to gain and gain! More engineers (now 30,000) are listed, and therefore have a direct, personal interest in this DIRECTORY.

Up-to-dateness is almost a mania with IRE DIRECTORY compilers! Membership lists are corrected up to May 30th. Industry lists, compiled and classified by high speed IBM sorting methods are accurate to June 15th. No firm's report is older than 18 months.

Information at high speed! "Data the way an engineer thinks" is the key to IRE DIRECTORY classifications. All products are divided into 10 fundamental groups, many of which parallel professional group organization. The grouping plan makes this the fastest working directory you ever used! No components are mixed with test equipment—you turn right to a section where each item belongs.

Yet good engineering detail is maintained. 99 basic classes of products under these ten sectional product directories keep listings from becoming cumbersome, but clearly define products. Overlapping listings are skillfully eliminated. Simplicity makes this book easy to work with—insures faster finding of facts when forgotten. Thus the faults of terminology listings are avoided.

Completeness is insured! Most firms make many products in a single classification. Wasteful, eye-confusing relisting of the same firms over and over is quite sensibly solved by using a system of codes under the 99 basic headings which actually provide 489 separate classifications. A more complete picture of what each firm's full line is results, but you travel through fewer listings. The "Copp Principle" of Directory indexing makes these lists wide, well marked highways to information—fast.

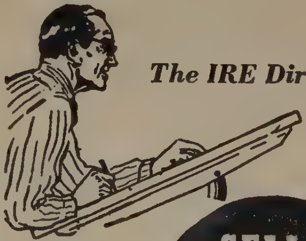
3000 Firms listed. The alphabetical directory gives a clear definition of these firms by showing any or all of the ten fundamental groups in which these firms belong after every name.

Machol Edge Index is just one more modern service to help the user find information fast.

Ads positioned with reason! In a DIRECTORY where ads play an important part in supplying information the user wants and needs, it makes good sense to cross-reference every advertiser in each listing so that the user can quickly find more detail. Ads are also placed facing company alphabetical listings, or in the product section in which they properly belong. No effort is spared to "organize" ad information.

More advertisers—more information! Never before have so many advertisers served IRE readers with so much information! The advertisers' list this year is truly a "social register" of this great industry.

Economy a service too! In spite of a rate increase since last year, due to increased circulation it costs less per reader than in 1952 to reach this selected engineer audience. Rates are: page—$420, ⅔—$280, ⅓—$140, 1/6—$70, and earned discounts apply to Proceedings advertisers. Catalog insert rates compete with postage—ask. (The DIRECTORY closes June 15th.)



The IRE Directory

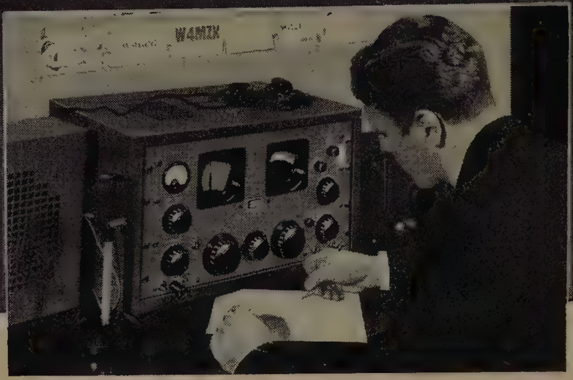
TO SELL THE RADIO INDUSTRY
TELL THE RADIO ENGINEERS

THE INSTITUTE OF RADIO ENGINEERS
BRyant 9-7550 • ADVERTISING DEPT., 1475 BROADWAY, NEW YORK 36, N. Y.

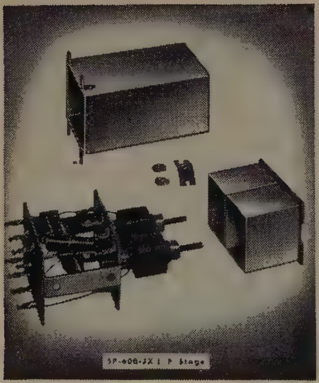
See Complete Product Questionnaire on Pages 161A, 162A, 163A and 164A

Stable I. F. Tuning...

means peak response at center frequency always!



Change the bandwidth without de-tuning when you operate an "SP-600-JX" Communications Receiver



Newest techniques in the art of receiver design and engineering are incorporated into the "SP-600-JX" to make it outstanding in quality and unexcelled in performance. Regardless of your past experience as a radio operator, amateur, or short-wave listener, you will be impressed by the superlative, advantages of the "SP-600-JX"

The aim at perfection in engineering and manufacture of the "SP-600-JX" has yielded a design which permits selection of any of six bandwidths (0.2, 0.5, 1.3, 3, 8, and 13 kc) with no de-tuning from center frequency.

Furthermore, these I. F. stages are so stable that once set at the factory, they are unlikely to ever need re-alignment again. Even a change of I. F. tubes has no effect upon alignment of this superior receiver.

Write to the Hammarlund Manufacturing Company, Inc., 460 West 34th St., New York 1, N. Y. for more details on the SP-600-JX. Ask for Bulletin 116.

●

Hammarlund introduces the new "HQ-140-X"! This medium priced receiver, which was previewed at the recent IRE Show, is a professional type receiver for amateur operators and short-wave listeners. It incorporates all the features that have made "HQ's" famous, along with the most recent advances in the art of receiver design. For detailed information ask for Bulletin 117.

HAMMARLUND

Meetings with Exhibits

● As a service both to Members and the industry, we will endeavor to record in this column each month those meetings of IRE, its sections and professional groups *which include exhibits.*

Δ

May 11, 12 & 13, 1953

National Conference on Airborne Electronics Hotel Biltmore, Dayton, Ohio.

Exhibits: Paul Clark, 120 West Second St., Dayton 2, Ohio.

Δ

August 19, 20, 21, 1953

1953 Western Electronics Show and Convention, Civic Auditorium, San Francisco, Calif.

Exhibits: Heckert Parker, 1355 Market St., San Francisco 3, Calif.

Δ

September 21, 22, 23, 24 & 25, 1953

Eighth National Instrument Conference and Exhibit. Hotel Sherman, Chicago, Ill.

Exhibits: Richard Rimbach, 921 Ridge Ave., Pittsburgh 12, Pa.

Δ

September 28, 29 & 30, 1953

National Electronic Conference Hotel Sherman, Chicago.

Exhibits: Orville Thompson, c/o DeForrest's Training Inc., 2735 N. Ashland Ave., Chicago 14, Ill.

Δ

February 4, 5 & 6, 1954

Sixth Southwestern I.R.E. Conference & Electronics Show, Tulsa, Oklahoma

Δ

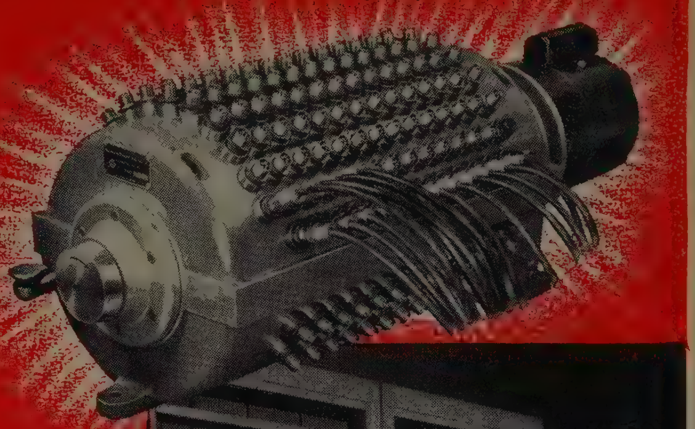
March 22, 23, 24 & 25, 1954

Radio Engineering Show and I.R.E. National Convention, New York City. Exhibits at Kingsbridge Armory and headquarters hotel Waldorf Astoria. Direct connections by subway and by private express busses.

Exhibits Manager: Wm. C. Copp, 1475 Broadway, New York 36, N.Y.

DIFFUSED JUNCTION GERMANIUM RECTIFIERS

Key to an "Electronic Memory"



GERMANIUM DIODES

For use where size, long-life, and reliability under all weather conditions are important factors. General Electric is the largest supplier of germanium diodes in the country.

DIFFUSED JUNCTION GERMANIUM RECTIFIERS

Developed for radar and military communications. May be applied to computers, magnetic amplifiers, telephone switchboards, and many other electronic fields.

ERA MAGNETIC DRUM STORAGE SYSTEMS
St. Paul, Minnesota

400 General Electric JA1A1 rectifiers were used in the storage system shown under construction above.

● ERA Magnetic Drum Storage Systems keep pace with increased machine operating speeds for rapid access "memory" of initial data, commands, intermediate and final results of computations. Here, where efficiency and dependable performance are of paramount importance G-E Diffused Junction Germanium Rectifiers are the first choice of Remington-Rand's Engineering Research Associates Division. J. L. Hill, Staff Electronics Engineer says: "Results from using G-E diffused junction germanium rectifiers in our systems have been excellent!"

Write for the new G-E Junction Rectifier Booklet showing complete specifications: *General Electric Co., Section 5253, Electronics Park, Syracuse, N.Y.*

NEWS FROM OUR ADVANCED DEVELOPMENT LABORATORIES

Collector dissipations of several watts have been obtained from diffused junction transistors built in the laboratory. These units have junction areas of only 1 mm^2 but utilize a case which is especially designed to remove heat more efficiently.

You can put your confidence in—

1878 75 1953
YEARS OF ELECTRICAL PROGRESS

GENERAL ELECTRIC

A new HIGH in operating temperatures
A new LOW in size...

metallized-paper
CAPACITORS

Smallest size—highest operating temperature! These Aerovox metallized-paper capacitors are *different* because of the exclusive thermo-setting impregnant—*Aerolene*. The solidly imbedded section is proof against vibration and displacement. And the exceptionally good characteristics remain good throughout longest service life.

Which accounts for widespread preference for Aerovox metallized-paper capacitors in telephone switchboard equipment, guided missiles, airborne receivers, interference filters, electronic calculators and other assemblies requiring maximum temperature rating, minimum space factor, and superlative reliability.

Available in hermetically-sealed metal-case tubulars, "bathtubs," cardboard tubulars, and other case styles, *function-fitted** to your needs.

Let our metallized-paper capacitor *specialists* with their outstanding application-engineering background, function-fit such units to your circuitry, associated components, operating conditions. Literature, quotations, delivery schedules, on request.

FUNCTION FITTED

AEROVOX capacitors

AEROVOX CORPORATION
NEW BEDFORD, MASS.

HI-Q® DIVISION
OLEAN, N. Y.

WILKOR DIVISION
CLEVELAND, OHIO

In Canada: AEROVOX CANADA LTD., Hamilton, Ont. JOBBER ADDRESS: 740 Belleville Ave., New Bedford, Mass.
Export: 41 E. 42nd St., New York 17, N. Y. • Cable: AEROCAP, N. Y.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

DC to AC Converters

A new line of dc-to-ac custom converters has been announced by **Carter Motor Co.**, 2640 N. Maplewood Ave., Chicago 47, Dept. 4, Ill., manufacturers of rotary power supplies.

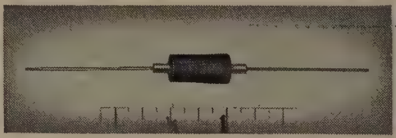
The "custom" converters supplement the Carter "super" converters. The new models, of 300, 400, and 500 watt ac output capacity as contrasted with the 250 watt maximum capacity of the regular line, are specially engineered for commercial and industrial applications requiring higher output capacity than heretofore available. The various models operate from battery power or line voltage of 12, 24, 28, 32, 64, 115 or 230 volts dc.

The frame of each is cast with pole shoes and field ring in one piece, eliminating losses and simplifying construction. Transformer grade armature laminations are specially designed for converter service, and are cross stacked to reduce eddy current and hysteresis losses. Triple and quadruple insulated magnet wire assures maximum protection from shorted windings.

All "custom" converters are available with manual frequency control.

New Diodes

Transitron Electronic Corp., 407 Main St., Melrose, Mass., announces a new line of gold bonded germanium diodes.



These diodes feature back resistance greater than a megohm at 100 volts inverse, as well as high forward conductance. Designed for extreme ruggedness and reliability, they are mechanically interchangeable with clip-in types. Long life under adverse conditions is insured by careful quality control of processing, inert humidity-protective filling, and the basic stability of the gold bonded junction. These diodes are also available in standard grades.

(Continued on page 9A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 8A)

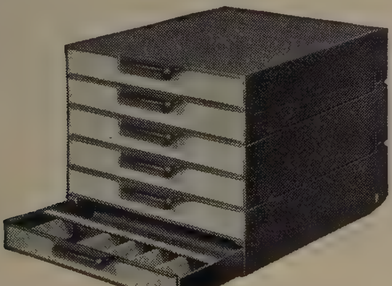
Miniature Terminal Blocks

Kulka Electric Mfg. Co., Inc., 633 So. Fulton Ave., Mt. Vernon, N. Y., has developed a new miniature terminal block. This new unit, the manufacturer claims, has all the electrical characteristics and physical stamina of blocks twice its size.

Overall length, with maximum of 22 double-screw terminals, is 6 inches. Height, including barrier, is 5/16 inch. Width is 5/80 inch. Terminals are completely separated by the high barriers, which increase creepage distance between live parts and eliminate possible shorts from frayed wires. Made of molded thermosetting plastics of high tensil strength bakelite for general commercial use, and of CFG, MME, and MDG in compliance with military specs MIL-P-14C. Supplied with 1 to 22 terminals (44 binder screws). Screws are 2/56×3/16 inch long, of nickel-plated brass. Also available are marker strips of fibre or bakelite for placing beneath blocks for designating terminals and for extra insulation. For further information, or complete catalog write the manufacturer.

Small Parts Cabinet

The **Equipto Div., Aurora Equipment Co.,** 422 Cleveland Ave., Aurora, Ill., has introduced the new "Little Gem" steel storage cabinet which they claim will provide quicker access to a wider variety of tiny parts than anything yet conceived. The cabinet is designed for use either individually, in stacks, under counters, or on shelving.



The drawer of the "Little Gem" measures 11×11×1¼ inches. It accommodates up to 28 adjustable compartments enclosed on all four sides and bottom. Tiny parts can't slip out, become damaged, and jam the drawer. Front of compartments is curved for easy withdrawal of parts, overhang at rear prevents shuffling of items when drawer is jerked open or slammed shut, and a label holder identifies each compartment.

(Continued on page 20A)

SERIES HV

HI-Q® ceramic Capacitors*

Tiny, yet so mighty, in guarding against voltage breakdowns. Yes, special dielectric materials developed by ceramic pioneer-specialists do safeguard your circuitry, associated components, operational conditions, reputation.

The HI-Q Series HV line includes extra-severe-service *slug type* ceramic capacitors in ratings up to 20,000 V. D. C. W.; *disks* up to 6,800; *tubulars* to 7,000; and high-voltage plates where cubical configuration permits greater space utilization.

* FUNCTION-FITTED:
Our engineers will gladly work with you in evolving the best engineering and economical solution of your ceramic-capacitor problem. Literature on request.

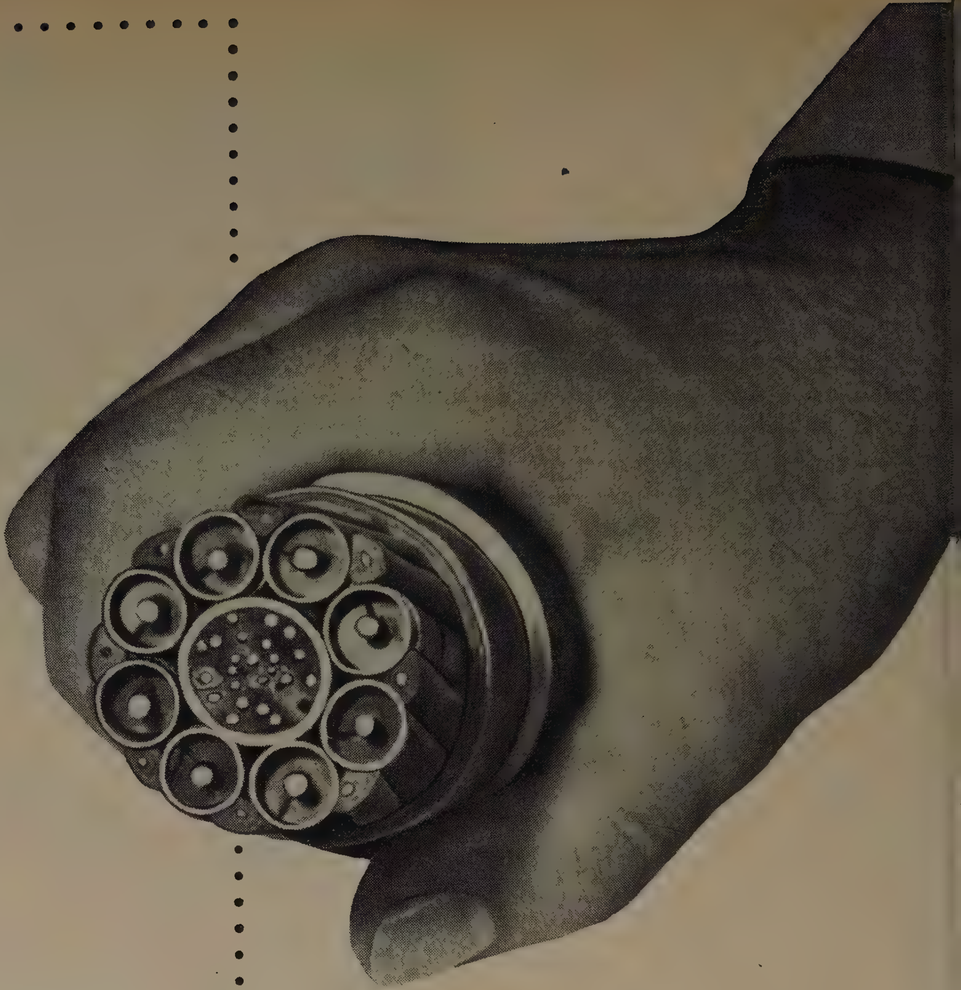
HI-Q® DIVISION
AEROVOX CORPORATION
OLEAN, N.Y.

AEROVOX CORPORATION
NEW BEDFORD MASS.

WILKOR DIVISION
CLEVELAND, OHIO

Export: 41 E. 42nd St., New York 17, N. Y. • Cable: AEROCAP, N. Y.
• In Canada: AEROVOX CANADA LTD., Hamilton, Ont. JOBBER ADDRESS: 740 Belleville Ave., New Bedford, Mass.

Pipes
that
grew
without
getting
bigger



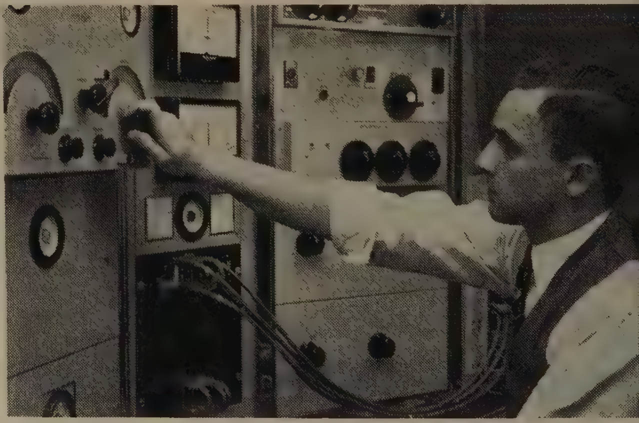
Cross-section of coaxial cable. To triple capacity, Bell Laboratories and Wester
Electric engineers had to make 1000 amplifiers work perfectly in tandem . .
feed repeater power along the same cable that carries messages . . . put sig
nals on and off the line at numerous cities along the route without distortio

Pencil-size pipes carry telephone messages and television across country through the Bell System's coaxial cable. Once, each pipe could carry 600 voices, or one television program. Now it can carry 1800 voices, or 600 voices *plus* a broadcast quality television program.

Yet the pipes aren't any larger. They are being made into triple-duty voiceways by new repeaters, new terminal equipment and other transmission advances developed by Bell Laboratories engineers.

The conversion expense is less than the cost of laying extra coaxial cables. But it calls for highly refined manufacturing procedures, made possible only by close co-operation of Bell Laboratories and Western Electric, manufacturing unit of the Bell System.

In improving the coaxial cable system they created more than 20 years ago, engineers at Bell Telephone Laboratories devised a new way to give America still better telephone service, while the cost stays low.



Laboratories engineer tests new triple-duty coaxial system. It marks the fi
time that telephone conversations and television can travel through the sa
pipes at the same time. With a wider frequency band being transmitted, b
problem was to eliminate interference between the two types of signals.

AMERICAN TELEPHONE & TELEGRAPH CO. BELL SYSTEM AND ASSOCIATED COMPANIES

BELL TELEPHON
LABORATORIES

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREE
FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIEL

HUGHES
SETS NEW STANDARDS OF DIODE CONDUCTANCE

HUGHES NOW OFFERS for commercial application eight new RTMA germanium diode types equivalent in every respect to Hughes regular subminiature types—and *in addition* carrying forward current minima of 10 ma. and 20 ma. at +1 volt!

THESE HIGH-CONDUCTANCE HUGHES DIODES, a product of Hughes Research and Development Laboratories, provide better combinations of high peak inverse voltage, high back resistance and low forward resistance than have ever before been available in production quantities. Volume orders for these new types can be filled from stock.

HUGHES GERMANIUM DIODES have proved consistently able to meet exacting requirements in airborne electronic equipment for navigation, fire control, and guided missiles. Besides having the advantages of germanium diodes over vacuum tubes, HUGHES DIODES alone are

each HUMIDITY-CYCLED
each TEMPERATURE-CYCLED
each JAN SHOCK-TESTED

HUGHES DIODES are also supplied to special customer specifications, including high temperature electrical requirements.

Address inquiries to Dept. PR

HUGHES GERMANIUM DIODE ELECTRICAL SPECIFICATIONS AT 25° C.

Description	RTMA Type	Test Peak Inverse Voltage* (volts)	Maximum Inverse Working Voltage (volts)	Minimum Forward Current @ +1 v (ma)	Maximum Inverse Current (ma)
High Peak	1N55B	190	150	5.0	0.500 @ −150 v
	1N68A	130	100	3.0	0.625 @ −100 v
High Back Resistance	1N67A	100	80	4.0	0.005 @ −5 v; 0.050 @ −50 v
	1N99	100	80	10.0	0.005 @ −5 v; 0.050 @ −50 v
	1N100	100	80	20.0	0.005 @ −5 v; 0.050 @ −50 v
High Back Resistance	1N89	100	80	3.5	0.008 @ −5 v; 0.100 @ −50 v
	1N97	100	80	10.0	0.008 @ −5 v; 0.100 @ −50 v
	1N98	100	80	20.0	0.008 @ −5 v; 0.100 @ −50 v
High Back Resistance	**1N116**	75	60	5.0	0.100 @ −50 v
	1N117	75	60	10.0	0.100 @ −50 v
	1N118	75	60	20.0	0.100 @ −50 v
General Purpose	1N90	75	60	5.0	0.800 @ −50 v
	1N95	75	60	10.0	0.800 @ −50 v
	1N96	75	60	20.0	0.800 @ −50 v
JAN Types	1N126**	75	60	5.0	0.050 @ −10 v; 0.850 @ −50 v
	1N127†	125	100	3.0	0.025 @ −10 v; 0.300 @ −50 v
	1N128‡	50	40	3.0	0.010 @ −10 v

*That voltage at which dynamic resistance is zero under specified conditions. Each Hughes Diode is subjected to a voltage rising linearly at 90 volts per second.

**Formerly 1N69A. †Formerly 1N70A. ‡Formerly 1N81A.

New types in red.

SEMICONDUCTOR
SALES DEPARTMENT

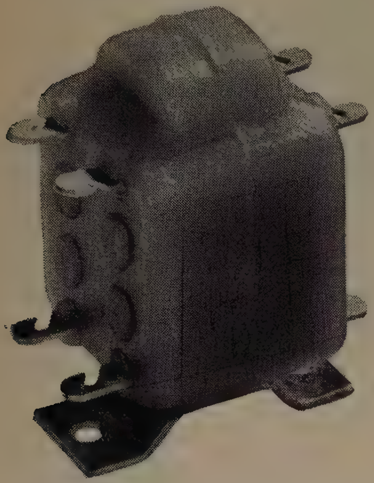
HUGHES

Aircraft Company
Culver City,
California

(Continued from page 9A)

Molded Transformers

A new line of molded transformers marketed under the name "Ken-Seal" has been announced by **Kenyon Transformer Co.,** 840 Barry St., New York 59, N. Y.



The molding process was chosen in preference to dipping or encapsulation because it supplies the demand for units of exceptionally light weight, small size and low cost without any sacrifice in hermetic sealing or other efficiency. In addition, molding produces a finished product which is uniform and controllable to definite dimensions. The component is now being manufactured as a production item.

Push-Button Oscillator

The **Krohn-Hite Instrument Co.,** 580 Massachusetts Ave., Cambridge, Mass. announces a new Push-Button Oscillator (Model 440-A) designed for applications requiring very low distortion or extremely good frequency stability and resetability. It provides both sine waves and square waves at a frequency between 0.01 cps and 100 kc.

For fine control of frequency, three banks of ten push-button switches are provided. An additional vernier control varies the frequency continuously by an amount equal to the increment between adjacent buttons of the third switch bank.

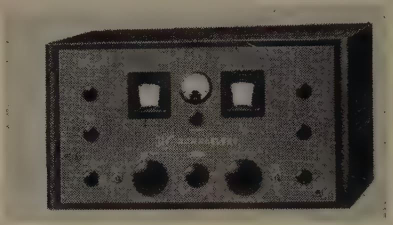
Hum and distortion are attenuated when the setting of the calibrated logarithmic output level control is reduced and are thus maintained at a constant low percentage of the desired output signal.

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

This instrument is suited for bridge measurements, tuned filter alignment, rapid spot-frequency checks, and distortion measurement. Priced at $450.

Communications Receiver

A new general purpose superheterodyne communications receiver, the "HQ-140-X," for use by commercial and amateur radio operators and other shortwave listeners, is now being introduced by the **Hammarlund Manufacturing Co. Inc.,** 460 W. 34 St., New York 1, N. Y.



The receiver is a table-top model with a continuously tunable frequency coverage of from 540 kc to 31 mc (555 to 9.7 meters) in six convenient bands, and includes a self-contained power supply.

Band spread tuning is available on the four higher frequency ranges, with direct calibration for the 80, 40, 20, 15 and 10 meter amateur bands. Calibration charts may be made easily for use with the arbitrary bandspread logging scale to tune other ranges.

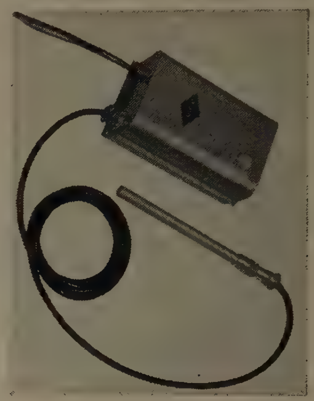
The receiver's high sensitivity makes possible reception of even the weakest stations because of the inherently high signal-to-noise ratio and the Hammarlund noise limiter. The special patented Hammarlund crystal filter provides selectivity for the high attenuation of closely adjacent interfering signals.

Liquid Level Control

The new Level Control manufactured by **Thermo Instruments Co.,** 1166 El Camino Real., Belmont, Calif., provides adjustment of liquid level and cut-in, cutout differential over very wide limits. The design for this new item is based on the capacitive action of liquid surrounding a porcelain enamel-covered electrode.

In operation, the new unit consists of the probe which is mounted directly at the location of the controlled liquid; a connecting cable which can be 1,000 feet long if necessary; and the control unit which can thus be located for operating convenience. The two main controls (liquid level and differential) are designed for screwdriver adjustment, while, a vernier on liquid level is operated by a panel-front knob.

Standard models operate from 115-volt 60 cps supply, while special units are available for 230-volt or 25 cps operation. The snap-action relay included in the unit is rated for 10 amperes at 115 and 230 volts. An indicator light in the panel front indicates operation of the relay—burning at full brilliance when the relay is open, at half brilliance when the relay is closed.



The differential range varies with the type of service but, as an example, for ammonia control the standard unit operates between approximately 1 inch and 5 inches. Wider ranges can be supplied with special units.

Rheostats

Ohmite Manufacturing Co., 4897 W. Fluornoy St., Chicago 44, Ill., has just announced that four of their wire-wound, vitreous-enameled rheostat models, formerly available only on a made-to-order basis, are now being carried in stock for immediate delivery.

The rheostats most recently made available from stock are: Model G, 75 watt; Model P, 225 watt; Model T, 750 watt; and Model U, 1,000 watt. (Only the two larger sizes are shown in the illustration.) All sizes are furnished in a wide range of resistance values; 0.5 to 10,000 ohms for the Model G, and 1 to 2,500 ohms for Models P, T, and U.

(Continued on page 48A)

max*

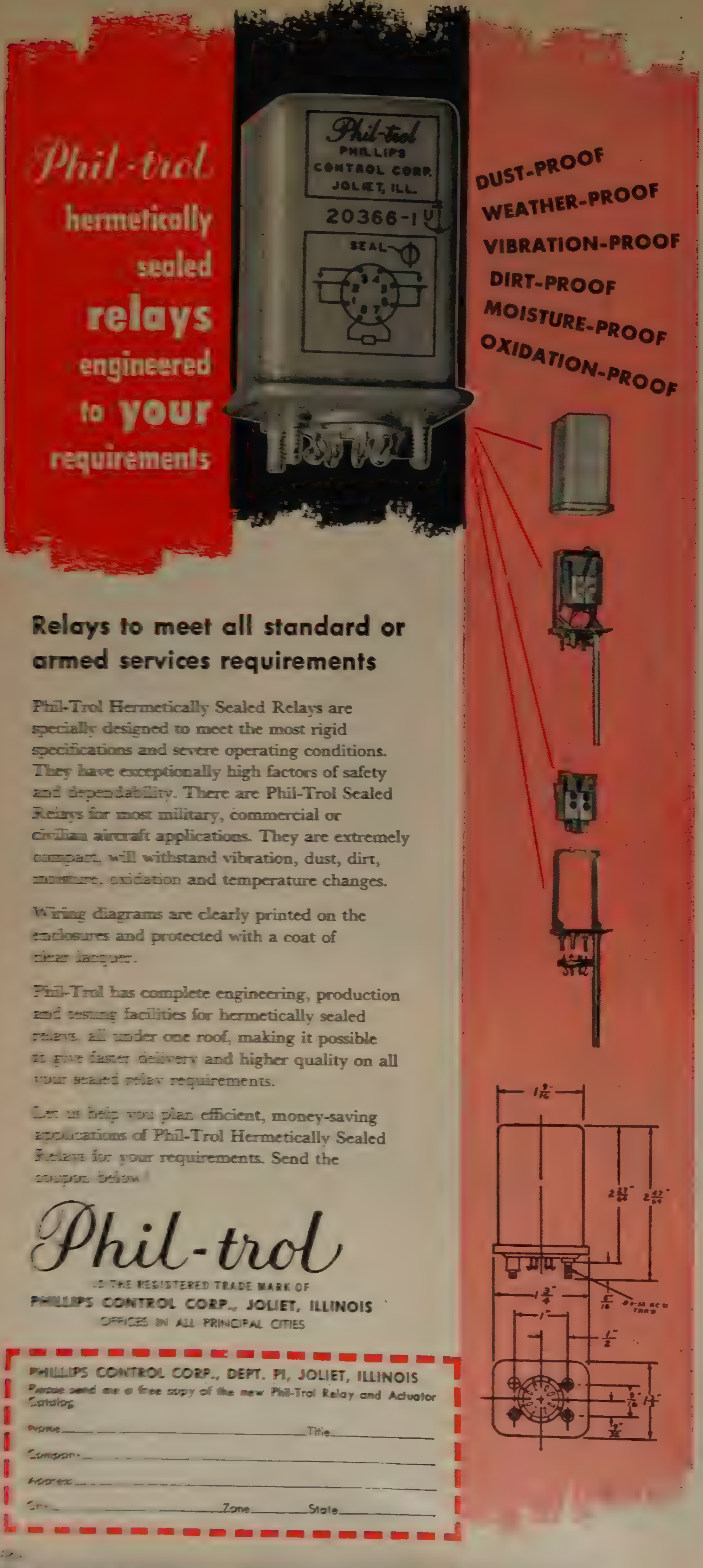
* REGISTERED TRADE NAME

A-27 *RF* LACQUER

MANUFACTURED ONLY BY

Communication Products Company, Inc.

MARLBORO, NEW JERSEY



Phil-trol hermetically sealed relays engineered to your requirements

DUST-PROOF
WEATHER-PROOF
VIBRATION-PROOF
DIRT-PROOF
MOISTURE-PROOF
OXIDATION-PROOF

Relays to meet all standard or armed services requirements

Phil-Trol Hermetically Sealed Relays are specially designed to meet the most rigid specifications and severe operating conditions. They have exceptionally high factors of safety and dependability. There are Phil-Trol Sealed Relays for most military, commercial or civilian aircraft applications. They are extremely compact, will withstand vibration, dust, dirt, moisture, oxidation and temperature changes.

Wiring diagrams are clearly printed on the enclosures and protected with a coat of clear lacquer.

Phil-Trol has complete engineering, production and testing facilities for hermetically sealed relays, all under one roof, making it possible to give faster delivery and higher quality on all your sealed relay requirements.

Let us help you plan efficient, money-saving applications of Phil-Trol Hermetically Sealed Relays for your requirements. Send the coupon below!

Phil-trol

IS THE REGISTERED TRADE MARK OF
PHILLIPS CONTROL CORP., JOLIET, ILLINOIS
OFFICES IN ALL PRINCIPAL CITIES

PHILLIPS CONTROL CORP., DEPT. PI, JOLIET, ILLINOIS
Please send me a free copy of the new Phil-Trol Relay and Actuator Catalog

Name_________________________Title____________
Company______________________________________
Address______________________________________
City________________Zone_______State__________

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 20A)

Voltage Regulated Power Supply

Lawn Electronics Co., East Freehold Rd., Freehold, N. J., is now in production on their Model 630-A regulated dc power supply.

This unit features 1/10 of 1 per cent regulation, less than 1 millivolt ripple, and less than $\frac{1}{2}$ ohm output impedance. The output voltage is continuously variable from 0 to 600 volts, with either the positive or negative terminal grounded. The unit will supply up to 300 milliamperes at any voltage setting. The unit also features a bias supply variable from 0 to -250 volts stabilized to 0.1 volt and a 6.3 volt 6 amperes, center tapped filament supply.

The dimensions of the unit are 19 inches wide by $8\frac{3}{4}$ inches high by $10\frac{1}{2}$ inches deep.

Rheostat Tandem Coupling Kits

Two new rheostat coupling kits, which enable purchasers to mount certain standard Ohmite rheostats in tandem, are now being offered for sale through distributors by **Ohmite Manufacturing Co.,** 4835 W. Fluornoy St., Chicago 44, Ill.

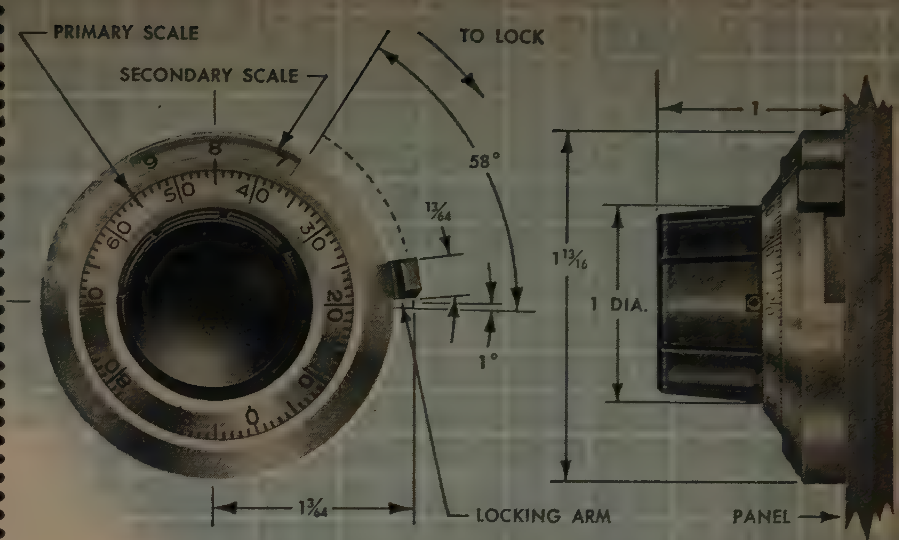
Formerly, Ohmite tandem rheostats had to be made to order. With the new kits, distributors can assemble units in tandem from standard items carried in stock, or can sell coupling kits for assembly by the purchaser.

Each kit consists of a steel "U" frame, mica washer, coupling, Allen wrench, and assembly instructions. The large frame is designed for use with Ohmite Model G, K, or L rheostats. The small frame is designed for use with Ohmite Model H or J rheostats.

Write for Bulletin No. 143.

(Continued on page 63A)

Save Time, Eliminate Errors, with the new multi-turn
model RA precision Duodial



Instant, accurate readings

distinctive beauty... quality "feel"... simple installation!

The new RA Duodial—product of the world's largest manufacturer of precision potentiometers—establishes a new standard of beauty and quality in multi-turn indicating dials. Finished in satin-chrome, with non-metallic parts of black nylon, the unit adds a distinguished appearance of quality and excellence to the finest instrument panels—and its precise operation gives a smooth "feel" that is unequalled. *From every standpoint—readability, appearance, operation, construction—here is a dial worthy of the highest quality electronic instruments!*

Unique Jump Mechanism

With its glare-proof satin finish and recessed black numerals that will not wear off, the RA Duodial is not only beautiful but is unusually easy to read. Moreover, the secondary dial is driven by a unique jump mechanism that keeps the dial stationary until the primary dial has completed a full revolution—then the turns-indicating dial "jumps" to the next numeral. Thus, the index always points *directly* to the number showing the particular helical turn on which the slider is positioned, eliminating errors in dial readings and settings.

Another convenience feature—three numbers show in the window at all times so that the operator knows instantly in which direction the dial is to be rotated to make the next setting. And with 10 turn potentiometers, readings are made directly in decimal equivalents of the slider position on the resistance winding—simply, accurately, and with maximum convenience for any resistance range.

Vibration-Proof Lock

All RA Duodials are equipped with a positive *vibration-proof* locking mechanism that can be easily and instantly set by the same hand that is adjusting the knob. Locking is accomplished by means of a cam actuated brake shoe which acts radially against an inner drum. This arrangement eliminates any possibility of dial movement during or after setting.

Easy To Mount On Panel

The RA is unusually compact—only 1-13/16" diameter (the same as a Model A Helipot)—and comes completely assembled, with mounting parts and hex wrench included. Installation is extremely simple. Set the dial and potentiometer at zero. Place the shaft through panel hole. Place lug plate over shaft, and mounting nut on potentiometer bushing. Then place the RA dial over shaft, lining up the register hole with lug—and tighten set screws. *It's as easy as that!*

In addition, the mounting nut is so designed that it is adaptable to thin (1/8" and under) or thick panels by simply reversing ends. No problems of adapting the unit to *your particular* panel requirements!

Finest Construction Throughout

In all respects the RA Duodial is built to maintain its attractive appearance and quality "feel" throughout its long life. Metal parts are machined from die-cast alloy and plated in accordance with specifications MIL P6871 and QQ P416 (1) for corrosion resistance. Non-metallic parts are made of long-lived nylon, with nylon jump gear to assure smooth quiet operation of the secondary dial. And since the primary dial is connected directly to the potentiometer shaft, no wear or backlash can affect the accuracy of the settings.

Two allen-head set screws—positioned at 90°—lock the dial to the potentiometer shaft, and the black nylon knob insulates the instrument from hand capacity.

The RA DUODIAL is primarily designed for use with the 10-turn Model A HELIPOT. However, it is equally ideal for use with the 3-turn Model C or the ultra-precision models AN and CN when these potentiometers are equipped with bushing mounting. Additional numerals provided on the secondary dial make the RA adaptable for readings up to 15 turns for special applications.

An RAJ version of the RA Precision DUODIAL is available for use on the miniature Model AJ 3/4" 10-turn HELIPOT. The RAJ also fits other multi-turn devices with 1/8" shafts.

Contact your nearest HELIPOT representative for complete details—or write direct for Data File 506.

THE Helipot CORPORATION

A subsidiary of Beckman Instruments, Inc.

SOUTH PASADENA, CALIFORNIA

Field Offices: Boston, Rochester, New York, Philadelphia, Cleveland, Detroit, Chicago, St. Louis, Los Angeles, Seattle, Dallas, High Point, N. C. and Fort Myers, Florida. In Canada: J. S. Root, Toronto.
Export Agents: Frathom Co., New York 36, New York.

Lapp

ANTENNA STRAIN INSULATORS

● The largest of the porcelain rod insulators shown in the illustration develops 12,000 lb. strength. It is available, if specified, with rain shield and/or corona rings. All hardware is silicon aluminum alloy. Smaller units, in porcelain or steatite, are suited to lighter duty for strain or spreader use. Engineering and production facilities are also available for design and manufacture of units to almost any performance specification. Write for Bulletin 301, with complete description and specification data. Lapp Insulator Co., Inc., Radio Specialties Division, 201 Sumner St., Le Roy, N. Y.

Lapp

Industrial Engineering Notes[1]

TELEVISION

The Federal Communications Commission granted construction permits for four new commercial television stations the week of March 20, bringing to 314 the number of post-freeze TV stations. A complete list of permits granted up to March 31 will appear in next month's section of the Industrial Engineering Notes.

RTMA ACTIVITIES

The Bureau of the Census, U. S. Department of Commerce, recently sent out a questionnaire to all radio-television manufacturers in order to obtain industry-wide sales figures for 1952. The current survey is sponsored by RTMA, but next year a similar questionnaire will be sent out as part of the Census of Manufacturers. Manufacturers are urged to send their replies to the Census Bureau as promptly as possible. The 1952 sales report covers home-type radios and television sets, auto receivers, phonographs and record players. **Earl I. Anderson, Assistant Manager, Industry Service Laboratory, RCA Laboratories Division, has been appointed Chairman of the Ad Hoc Committee assigned the responsibility of studying the bilateral interference between the color system based on NTSC standards and amateur operators. The RTMA Engineering Department filed a report with the FCC recently relating to the Commission's proposed rules for the assignment of fixed stations in the 72–76 meg. band.** Primarily the report covers the susceptibility of TV sets tuned to Channels 4 and 5 to interference from stations operating in the 72–76 meg. band. "The Engineering Department of RTMA, recognizing that certain information not now available or readily obtainable by the FCC would be of great help in establishing these rules, undertook to obtain, compile and evaluate this information," Engineering Department Director W. R. G. Baker pointed out. In addition to information by which FCC could establish a set of rules, Dr. Baker pointed out that "these methods differ from those outlined in Docket 10,315 primarily in the fact that more factors, such as antenna directivity patterns, station powers, antenna heights and direction to receiving site are considered. In addition, of course, the aforementioned receiver susceptibility curves are used."

NEW QUALITY CONTROL ORGANIZATION REVEALED BY THE AIR FORCE

The Air Force has announced a new quality control organization which consolidates the activities in this field formerly handled by the Directorates of Procurement and Production, Maintenance Engineering, and Supply and Service. The new

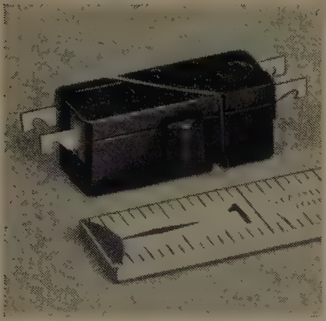
(Continued on page 78A)

---

[1] The data on which these NOTES are based were selected by permission from *Industry Reports* issues of February 27, March 6, 13, and 20, published by the Radio-Television Manufacturers Association, whose helpfulness is gratefully acknowledged.

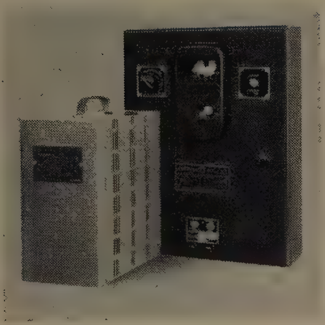
DIGEST

TIMELY HIGHLIGHTS ON G-E COMPONENTS



Switchettes are versatile, have high current rating

A wide range of design problems can be solved by G-E general-purpose switchettes. They are corrosion-proof, vibration-resistant, small, lightweight. Efficient at sea level or at 50,000 feet, in ambient temperatures from 200F to −70F. Ratings up to 230 volts, 25 amp. a-c; 250 volts, 25 amp. d-c. See Bulletin GEC-796.

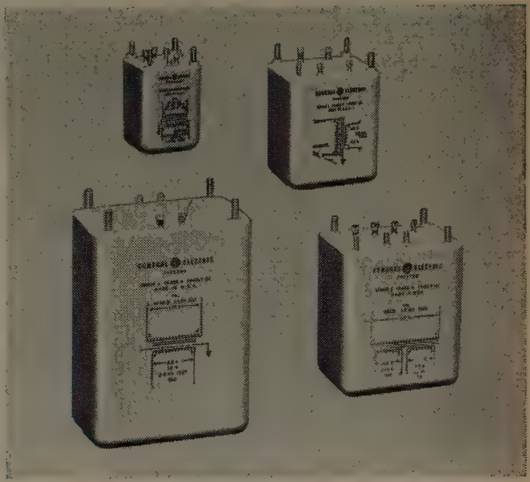


Inductrols—for automatic or manual voltage regulation

Compact design of G-E inductrols lets you fit them into any location. They offer micrometer-fine control, autotransformer efficiency. Hand-operated and automatically operated models are available for indoor service 600 v and below on circuits 3 to 520 kva. Bulletin GEC-795 covers single-phase inductrols; GEA-5824, 3-phase models.

New iron weighs only 8½ oz.

The new 120-v, 60-w G-E lightweight iron is designed for high-speed, production-line soldering on electronic, instrument, and communications equipment. Thin, 5/16-inch diameter shank gets the ¼-inch tip into places a regular iron can't reach. Balanced design allows the soldering of more joints per minute. Long-lasting Iron-clad tip needs no filing or dressing. See Bulletin GED-1583.



COMPLETE LINE includes 11 sizes

G-E cast-permafil* transformers designed to meet MIL-T-27 specs

The small, light design of General Electric's new line of cast-permafil transformers makes possible greater flexibility in many electronic designs. Sealing these solventless-resin-type transformers for life has eliminated the need for metal enclosures and fungus-proof coatings. Construction is simple—terminals are anchored directly in the tough, solid, shatter-resistant permafil mixture to cut size and weight by 20 per cent. Machined and punched parts have been kept at a minimum for lower cost.

Cast-permafil transformers have an expected life of 1000 hours or more at 130 C ultimate. The complete line of 11 sizes is available in various terminal arrangements, and is designed to meet MIL-T-27 (Grade 1) performance requirements. For more information, write General Electric Co., Sect. 667-25, Schenectady 5, N. Y.

EQUIPMENT FOR ELECTRONICS MANUFACTURERS

Components

- Meters, Instruments
- Dynamotors
- Capacitors
- Transformers
- Pulse-forming networks
- Delay lines
- Reactors
- Thyrite*
- Motor-generator sets
- Inductrols
- Resistors
- Voltage stabilizers
- Fractional-hp motors
- Rectifiers
- Timers
- Indicating lights
- Control switches
- Generators
- Selsyns
- Relays
- Amplidynes
- Amplistats
- Terminal boards
- Push buttons
- Photovoltaic cells
- Glass bushings

Development and Production Equipment

- Soldering irons
- Resistance-welding control
- Current-limited high-potential tester
- Insulation testers
- Vacuum-tube voltmeter
- Photoelectric recorders
- Demagnetizers

*Reg. Trade-mark of General Electric Co.

General Electric Company, Section B667-25
Schenectady 5, New York

1878 75 1953 YEARS OF ELECTRICAL PROGRESS

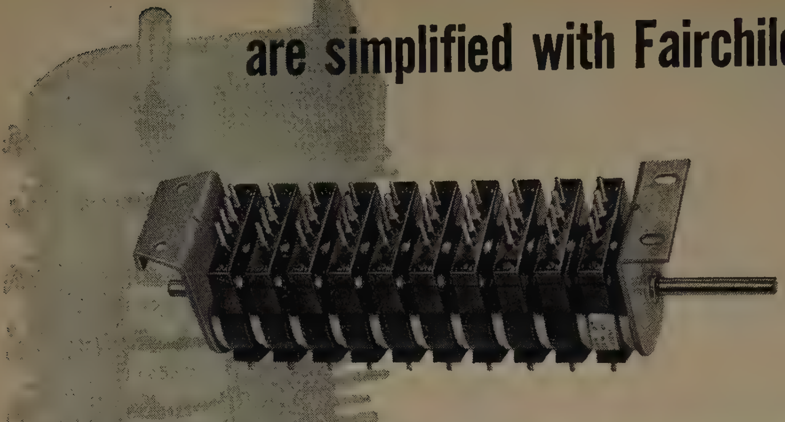
Please send me the following bulletins:
✓ for reference
✗ for immediate project

☐ GEA-5824 Three-phase Inductrols
☐ GEA-5935 Miniature Rectifiers
☐ GEC-795 Single-phase Inductrols
☐ GEC-796 Switchettes
☐ GEA-5754 Voltage Stabilizers
☐ GED-1583 Soldering Iron

Name ____________________

Company ____________________

City ____________________ State ________



maintenance and replacement are simplified with Fairchild

plug-in potentiometers

These plug-in type ganged potentiometers are another excellent example of Fairchild's service in meeting the special requirements of customers. The problem was to provide ganged precision potentiometers that would simplify maintenance of airborne fire control equipment through quick and easy replacement. A series of packaged plug-in units like that shown was the answer.

An entire gang can be replaced in a few minutes because only the end mounting plates are fastened down. There are no wires to disconnect or solder. Test points are provided on the top of each potentiometer so it can be checked quickly.

Maximum rigidity of the gang is assured by mounting the individual units on a single shaft. These plug-in potentiometers have the same mechanical and electrical tolerances and performance characteristics that have made the Model 746 unit the first choice for many critical applications.

Use the coupon below to get full information.

FAIRCHILD
PRECISION POTENTIOMETERS

Potentiometer Division, Department 140-34H1
Fairchild Camera and Instrument Corporation
Hicksville, Long Island, New York

Gentlemen:

Please send me complete information about Fairchild Precision Potentiometers and tell me how you might solve my potentiometer problems.

Name__________________________________

Position__________________________________

Company__________________________________

Address__________________________________

Industrial Engineering Notes

(Continued from page 74A)

group, which is under the direct supervision of the Commanding General of the Air Materiel Command at Wright-Patterson Air Base, is headed by Brig. Gen. W. P. Farnsworth. The new system is described by the Air Force as a "surveillance" type of quality control in which a check is maintained all along the production route rather than checking quality only at the end of the line. Plans reportedly also are under way to eliminate many of the long reports required under the previous system and to eliminate duplication of government inspection.

GOVERNMENT PERSONNEL

Frederick B. Lee of Vermont was nominated recently to be Civil Aeronautics Administrator to fill the post vacated by Charles Horne. Harmar D. Denny, Jr. was nominated to be a member of the Civil Aeronautics Board for the remainder of the term vacated by Donald W. Nyrop. **The following nominations were confirmed recently by Senate action:** James H. Douglas, Jr., of Illinois, to be Under Secretary of the Air Force; Maj. Gen. Daniel Noce to be Army Inspector General, with rank of Lieutenant General; Maj. Gen. Lyman L. Lemnitzer to be Deputy Army Chief of Staff for Plans and Research, with rank of Lieutenant General; Maj. Gen. Bryant LeMaire Boatner to be Air Force Inspector General, with rank of Lieutenant General; Val Peterson, of Nebraska, to be Federal Civil Defense Administrator.

ELECTRONICALLY CONTROLLED GUN UNVEILED BY THE ARMY

The Army recently unveiled its "Skysweeper," a completely electronically controlled antiaircraft gun. This is the first weapon with radar, electronic computer and gun on one carriage, fully integrating the gun and fire control equipment. The Skysweeper reportedly costs $385,000 complete with prime-mover and generator, but for security reasons the cost of the electronic equipment is classified information. The gun is designed to spot and track enemy aircraft flying at near sonic speeds at low and medium altitudes. Its radar equipment scans the sky automatically once every 40 seconds, transmitting its information to a viewing screen and automatic electro-mechanical computer. The computer automatically plots range, speed and course of approaching aircraft and feeds future target information into a power control which translates it into corresponding gun motion. The weapon also has automatic loading and firing features and can fire 45 rounds per minute of its proximity-fuse-equipped shells. Firing is started and stopped by either the radar operator or computer operator but while being fired the gun tracks and fires automatically.

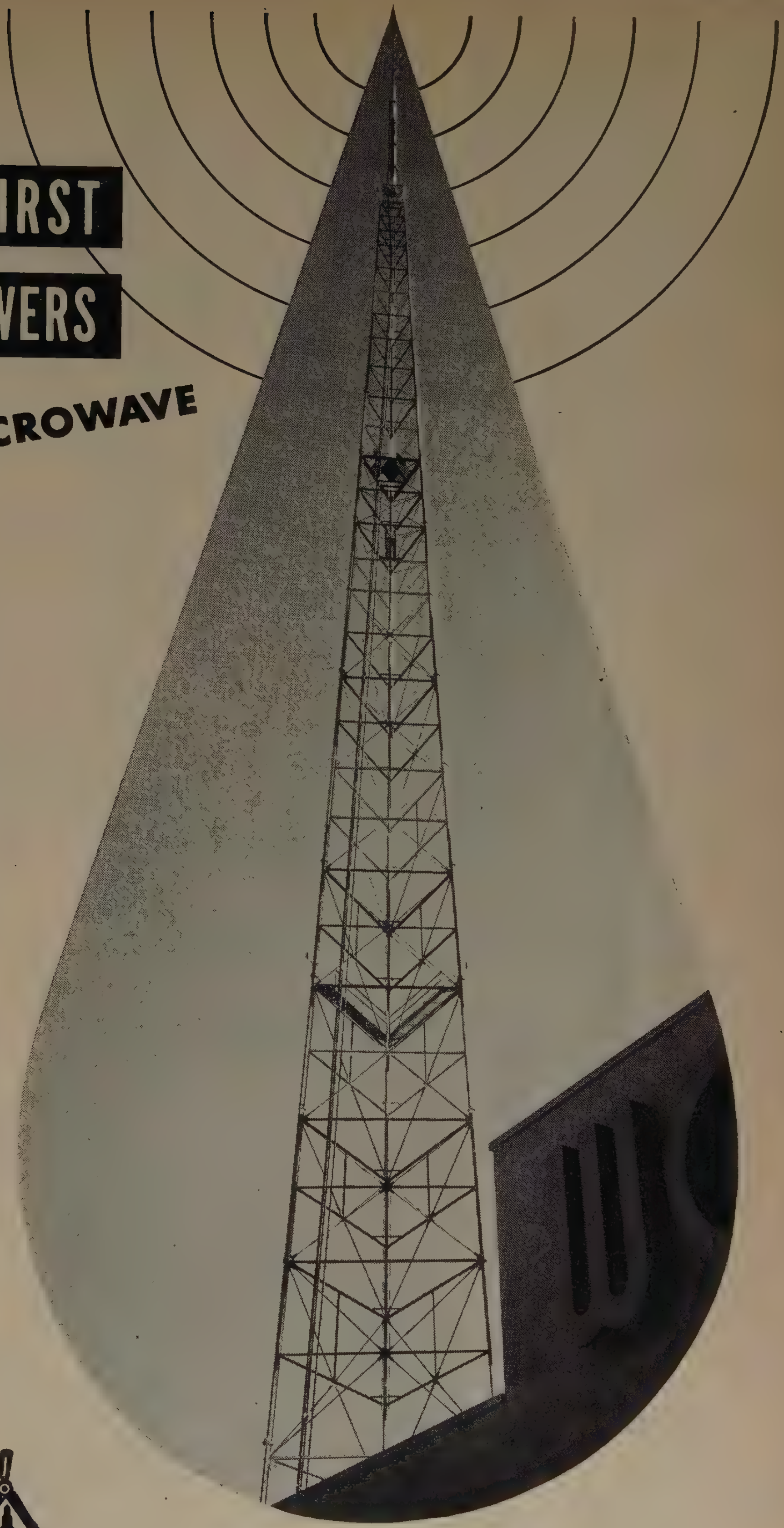
FCC ACTIONS

The Federal Communications Commission issued two Notices of Proposed Rule Making and one Order recently regarding

(Continued on page 80A)

ASK TRUSCON FIRST ABOUT STEEL TOWERS

FOR AM·FM·TV·MICROWAVE



● Truscon—first name in steel towers—offers you a background of experience unmatched in radio. Many hundreds of Truscon designed and engineered steel towers today stand strong and tall . . . in all kinds of weather . . . in all types of topography. Truscon facilities for the complete design and production of steel towers are modern and efficient.

Ask Truscon first . . . whether your requirements call for tall or small towers . . . guyed or self-supporting . . . tapered or uniform in cross-section . . . for AM, FM, TV or Microwave transmission.

Your telephone call or letter to any convenient Truscon district office or to "tower headquarters" in Youngstown will get your tower program going as soon as defense requirements permit.

TRUSCON
MARK OF MERIT
PRODUCTS

TRUSCON STEEL DIVISION
REPUBLIC STEEL CORPORATION
1072 ALBERT STREET • YOUNGSTOWN 1, OHIO

TRUSCON® a name you can build on

high gain

LOW COST

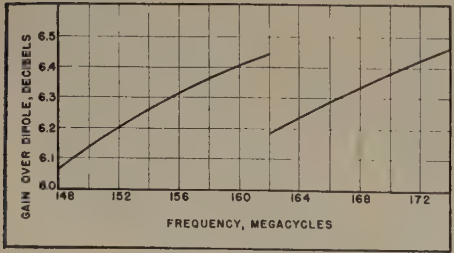
ANDREW

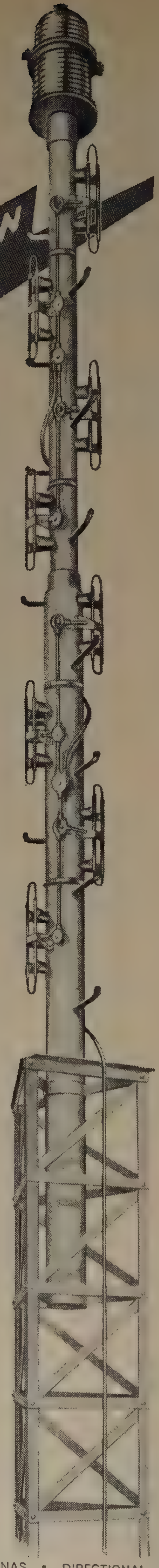
Andrew Omnidirectional Antenna for VHF Communications

No, this new High Gain Communications Antenna isn't cheap, but it does offer the most economical solution to your coverage problem. Whether you want maximum coverage for a specific transmitter power, minimum power or shortest tower for a specific coverage, or freedom from dead spots, the ANDREW Type 3000 Antenna is the least expensive solution. Why? Because talk-back is the limiting factor in mobile communications. Gain in the central station antenna costs less than increased power in every mobile unit.

ANDREW Type 3000 High Gain Communications Antenna offers better than 6 db gain in the 148-174 MCS band. This means that the power delivered to the receiver on both talk-out and talk-back is increased four times. The horizontal radiation pattern is circular.

Write for the ANDREW High Gain Antenna bulletin today!





Andrew
CORPORATION
363 EAST 75TH STREET, CHICAGO 19
ANTENNA SPECIALISTS
TRANSMISSION LINES FOR AM-FM-TV-MICROWAVE • ANTENNAS • DIRECTIONAL ANTENNA EQUIPMENT • ANTENNA TUNING UNITS • TOWER LIGHTING EQUIPMENT

Industrial Engineering Notes

(Continued from page 78A)

the use of various frequencies. An amendment to Part 14 of the Rules Governing Radio Stations in Alaska (other than amateur and broadcast) is contemplated which would change certain frequency assignments in the 1,500–3,500 kc band.

In another Notice of Proposed Rule Making, the Commission looks toward amending Part 11 of the Rules Governing Industrial Radio Services to provide for the use, on a shared basis, of the frequency 2,398 kc by stations in the Industrial Radio Services, except the Relay Press and Low Power Industrial Radio Services. By order, the Commission finalized, effective April 2, its earlier proposal to delete the frequencies 5,555, 5,560 and 5,565 kc from the assignable frequencies listed in Sec. 7.206(a) of the Rules Governing Stations on Land in the Maritime Services. A proposal to amend Part 8 of the Rules Governing Stations on Shipboard in the Maritime Services to delete frequencies 8,830 kc from assignable frequencies for ship telephone and 8,260 kc for ship telegraph stations, and to make 8,262.3 kc available for assignment to ship telephone stations, is being held in abeyance pending action in a related docket case.

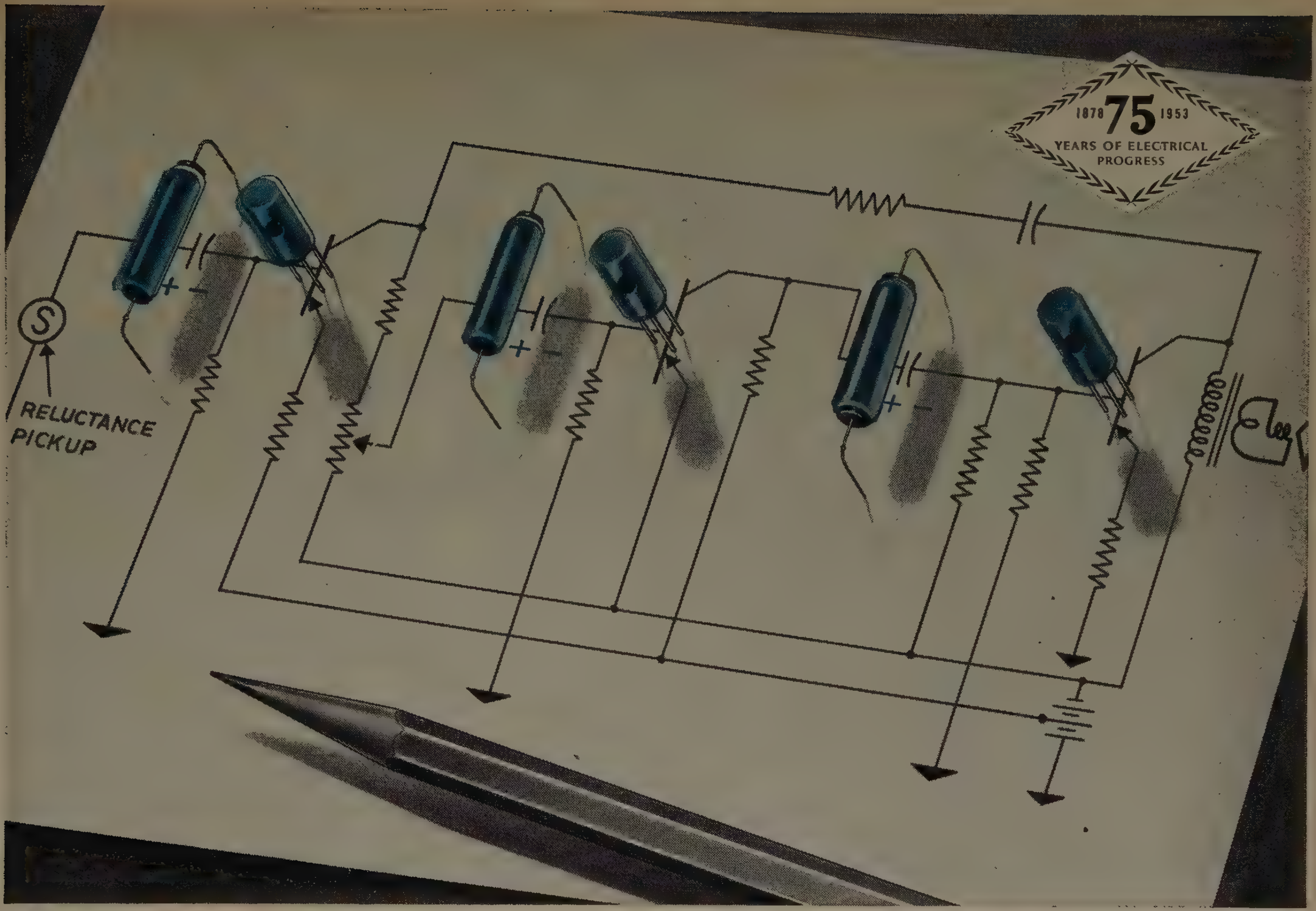
EXPORTS

RTMA headquarters recently received a letter from a manufacturer's agent in East Africa requesting information on the availability of a low-priced battery radio for sale in the area. There reportedly is a large demand for sets among the natives, if a sufficiently low price—about $6 at the factory—can be found. It is stated that the local governments are interested in having sets sold in the area and therefore the firm feels that it would be able to arrange dollar exchange without difficulty. Additional information may be obtained from Hugh Cowen, Director, R. E. Bunson (Sales) Ltd., P. O. Box 5456, Mailka House, Stewart St., Nairobi, Kenya, Africa.

MOBILIZATION

The U. S. Army Signal Corps celebrated its 90th birthday on March 3. In reviewing the past year, Chief Signal Officer Maj. Gen. George I. Back stated that the establishment in July of the Signal Corps Aviation Center at Fort Monmouth, N. J., was one of the major developments. Another was the Corps' development of a chain radar system, making it possible to trace missiles and rockets from firing point to target. A total of 107,471 contracts, or 73 per cent of all defense contracts let by the Signal Corps from July 1950 to 1952 were received by small business, Maj. Gen. Back said. This percentage represents a dollar value of $564,209,000 paid to small contractors by the Signal Corps. **A defense expansion goal for scientific research and development laboratories was announced recently by the Office of Defense Mobilization.** The unspecified goal provides for the expansion of specified types of research and development laboratories needed for the

(Continued on page 82A)



TRANSISTORS . . . TANTALYTIC CAPACITORS

teamed in 100-milliwatt tubeless amplifier

General Electric engineers at Electronics Park, Syracuse, have developed a new tubeless audio amplifier circuit that utilizes three junction transistors and three Tantalytic capacitors.

Although still experimental, this 3-stage amplifier promises significant advances in miniaturized equipments. It has a power output of 100 milliwatts—less than 10% distortion—and a power gain of 70 db.

Tantalytic capacitors were a "natural" for interstage coupling in the circuit because of their small size, large capacitance and low leakage current. They match the transistors in ruggedness and long operating life. And they will operate over a wide temperature range (−55°C to +85°C with at least 65% capacitance at −55°C). Other features include light weight, long shelf life, and hermetic sealing.

If you have a capacitor application where you need small size and superior performance, it will pay you to investigate Tantalytic capacitors. They're available in polar and non-polar construction and in ratings from 175 muf at 5 VDC to 12 muf at 150 VDC. For additional information use the convenient coupon below.

General Electric Company, Schenectady 5, New York.

General Electric Co., Section M 407-313
Schenectady 5, New York

Gentlemen: Please send me a copy of your free Bulletin(s)
☐ **GEC-808 and GER-451 "Tantalytic Capacitors"**
☐ **ECG-1 "Germanium Transistors"**

Name____________________

Company____________________

Street____________________

City__________ **Zone**____ **State**_____

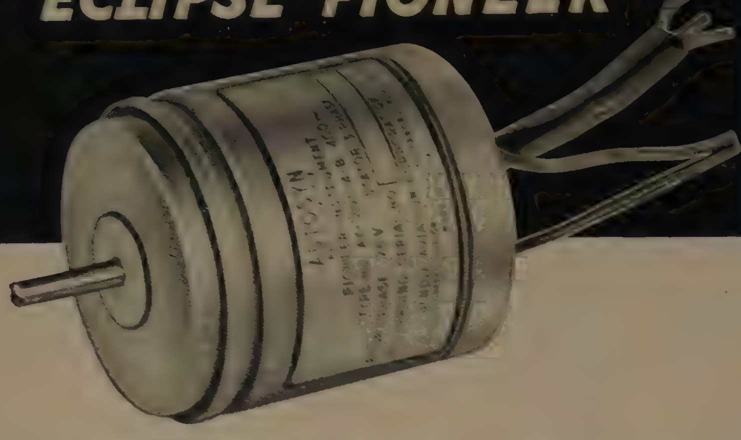
GENERAL ELECTRIC

Autosyn*

SYNCHROS

Precision-Built by

ECLIPSE-PIONEER



For more than 18 years, Eclipse-Pioneer has been a leader in the development and production of high precision synchros for use in automatic control circuits of aircraft, marine and other industrial applications. Today, thanks to this long experience and specialization, Eclipse-Pioneer has available a complete line of standard (1.431" dia. X 1.631" lg.) and Pygmy (0.937" dia. X 1.278" lg.) Autosyn synchros of unmatched precision. Furthermore, current production quantities and techniques have reduced cost to a new low. For either present or future requirements, it will pay you to investigate Eclipse-Pioneer high precision at the new low cost.

*REG. TRADE MARK BENDIX AVIATION CORPORATION

AVERAGE ELECTRICAL CHARACTERISTICS—AY-200 SERIES**

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes
Transmitters	AY201-1	26V, 400~, 1 ph.	225	1.25	25+j115	11.8	9.5	3.5	15
	AY201-4	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	20
Receivers	AY201-2	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	45
Control Transformers	AY201-3	From Trans. Autosyn	Dependent Upon Circuit Design				42.0	10.8	15
	AY201-5	From Trans. Autosyn	Dependent Upon Circuit Design				250.0	63.0	15
Resolvers	AY221-3	26V, 400~, 1 ph.	60	0.35	108+j425	11.8	53.0	12.5	20
	AY241-5	1V, 30~, 1 ph.	3.7	—	240+j130	0.34	239.0	180.0	40
Differentials	AY231-3	From Trans. Autosyn	Dependent Upon Circuit Design				14.0	10.8	20

**Also includes High Frequency Resolvers designed for use up to 100KC (AY251-24)

AY-500 (PYGMY) SERIES

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes
Transmitters	AY503-4	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	25.0	10.5	24
Receivers	AY503-2	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	23.0	10.5	90
Control Transformers	AY503-3	From Trans. Autosyn	Dependent Upon Circuit Design				170.0	45.0	24
	AY503-5	From Trans. Autosyn	Dependent Upon Circuit Design				550.0	188.0	30
Resolvers	AY523-3	26V, 400~, 1 ph.	45	0.5	290+j490	11.8	210.0	42.0	30
	AY543-5	26V, 400~, 1 ph.	5	0.1	900+j2200	11.8	560.0	165.0	30
Differentials	AY533-3	From Trans. Autosyn	Dependent Upon Circuit Design				45.0	93.0	30

For detailed information, write to Dept. G.

ECLIPSE-PIONEER DIVISION of
Bendix AVIATION CORPORATION
TETERBORO, NEW JERSEY
Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

Industrial Engineering Notes

(Continued from page 80A)

defense effort provided the construction and facilities are completed by January 1, 1956. Ralph S. Trigg, Acting Assistant Director for Production, said that this expansion goal will apply only to those research and development facilities which the sponsoring government agencies determine are necessary to meet defense research requirements that otherwise could not be met. Only those laboratories which have defense research and development contracts are eligible for rapid tax amortization under the goal.

New Type Reactor Produces Usable Electric Power

Climaxing a two and one-half year effort, the production of useful amounts of electric power by nuclear energy has been achieved from successful operation of a new type of reactor, an experimental homogeneous reactor, developed at the Oak Ridge National Laboratory, the Atomic Energy Commission reported recently. A pilot-model of the unique reactor system was brought up to its full design power of 1,000 kilowatts of heat output. The reactor steam then was switched to a turbine-generator and about 150 kilowatts of electricity was produced . . . enough to meet the needs of 50 average five-room dwellings.

Research

OTS Lists New Reports Covering Electronics Industry

New radio tubes for better microwave transmission, better tube manufacturing technique and improved processes for manufacturing transistors are among the technical developments for the electronics industry described in the February issue of the Bibliography of Technical Reports released by the Office of Technical Services, Department of Commerce. The following are of special interest to the electronics manufacturers:

"Ultra-High Frequency Deflection Oscillator" (PB 107583), available from the Photoduplication Section, Library of Congress, for $4.25 for microfilm and $12.50 in photostat form.

"Analysis of Magnetron Oscillations at Low Magnetic and Electric Field" (PB 108026), Photoduplication Section, Library of Congress, microfilm, $4.50, photostat, $13.75.

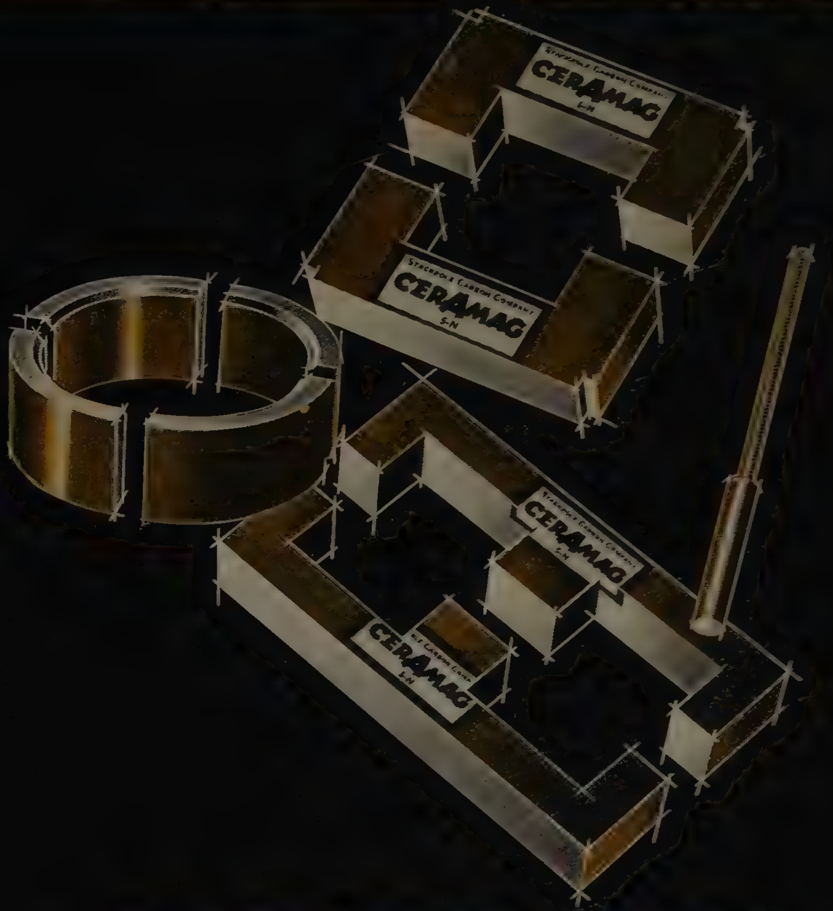
"Trionode, a Versatile Gas Tube" (PB 108307), Photoduplication Section, Library of Congress, $1.75 on microfilm, $2.50 in photostat form.

"Emission Life of Oxide Cathode Tubes" (PB 108039), available from National Research Council of Canada, Ottawa, Canada, for 50 cents.

"Line Focus Guns" (PB 108027), available from Photoduplication Section, Library of Congress, microfilm, $1.75, photostat, $2.50.

"Progress Report, 1 March 1952–30 June 1952" (PB 108001), available from Photoduplication Section, Library of Congress, microfilm, $2.00, photostat, $3.75.

(Continued on page 84A)



THE PRODUCTION UNIT IS LIKE THE SAMPLE . . . AND EACH PRODUCTION UNIT IS LIKE THE OTHER . . . *ELECTRICALLY AND MECHANICALLY!*

STACKPOLE
Ceramag
FERRITE CORES

Electronic Components Division, STACKPOLE CARBON COMPANY, *St. Marys, Pa.*

ORTHOSIL

3-Phase Laminations
Cut Costs, Weight, Space

When Transformer Engineers of Pasadena, Calif., contracted to build a 3ϕ 400 cps transformer for the guided missile program, Thomas & Skinner engineers were consulted for assistance. After thorough analysis, the new T & S EI ½″—3ϕ OrthoSil 4 mil lamination was recommended. With this new, thin orthographic iron-silicon lamination, Transformer Engineers were able to cut both weight and size 25%, in addition to substantially reducing the unit cost.

This success with 3ϕ applications is typical of Thomas & Skinner's new OrthoSil laminations. The 3ϕ series of OrthoSil laminations also include ⅜″ and ⅝″—and will soon include the EI ⅞″—3ϕ.

Transformers such as power and 3ϕ, chokes, saturable reactors, and filters are but a few of the many electrical components for which OrthoSil oriented laminations are recommended.

Write today—ask for new T & S Electrical Laminations Bulletin No. L-752.

Specialists in Magnetic Materials, Permanent Magnets, and Laminated Cores

THOMAS & SKINNER Steel Products Company, Inc.
1125 East 23rd Street, Indianapolis 7, Indiana

Industrial Engineering Notes

(Continued from page 82A)

"Study of Automatic Printed Circuit Techniques" (PB 108003), Photoduplication Section, Library of Congress, for $2.00 on microfilm and $3.75 in photostat form.

"Single Conductor Connector for Replacement of Bare Soldered Joints" (PB 107978), available from the Photoduplication Section, Library of Congress, for $1.75 in microfilm and $2.50 in photostat form.

"Capacitor Development" (PB 107812) available from the Photoduplication Section, Library of Congress, microfilm, $2.25, photostat, $5.

"Reconstituted Mica and Synthetic Mica" (PB 107814), available from the Photoduplication Section, Library of Congress, $3.50 for microfilm and $10 for photostat form.

CAA Actions

The Office of Aviation Safety of the Civil Aeronautics Administration has released its first published index of CAA type certificated radio equipment. The index, it was pointed out, does not include modifications to type certificated radio equipment. All radio equipment certificated through early February is included in the new index which, CAA said, would not be revised at regular intervals but only when warranted by the addition of new approvals. A CAA spokesman told RTMA that the agency is giving wide distribution to the index, both in the radio equipment and airplane manufacturing field. Additional copies, however, may be obtained through the CAA Office of Aviation Safety. **Following an FCC order of last November (RTMA Industry Report, Vol. 8, No. 53), improved air and ground communications is in the offing with the use of a new frequency at all CAA facilities, it was announced by Charles F. Horne, retiring Administrator of Civil Aeronautics.** Effective March 15, all CAA control towers and communications stations will establish a listening watch on 3023.5 kc which will ultimately replace the presently used 3105 kc. This is but one step in a world wide program which involves rearrangement of almost the entire high frequency spectrum, as planned by the International Administrative Aeronautical Radio Conference and approved by the U. S. Government. The overall plan will provide, for the first time in history, exclusive frequencies for aeronautical use.

Industry Statistics

Manufacturers billed $21,670,785.11 in sales of laboratory-production and service test equipment during 1952, according to a summary report prepared by the RTMA Statistical Department. The information is based on figures supplied by 12 reporting companies. Of the 1952 total, $14,477,800.74 in sales was accounted for by laboratory and production test equipment with the remaining $7,192,984.37 worth made up of service test equipment.

(Continued on page 85A)

Industrial Engineering Notes

(*Continued from page 84A*)

Office of Technical Service Issues New Reports in the Electronics Field

The Office of Technical Services, Department of Commerce, announced recently the publication of a report, "Design and Development of Miniature Hermetically Sealed Power Transformers," PB 101166s3, which tells how to achieve the smallest possible power transformers for use in electronic equipment. This report is available at the Photoduplication Section, Library of Congress, for $6.25 on microfilm and $21.25 in photostat form. Some of the new reports available and announced in the March OTS bibliography of Technical Reports are:

"Input Circuits for High-Fidelity Crystal-Video Receivers," (PB 108233), is available at the Photoduplication Section, Library of Congress for $2.25 on microfilm and $5.00 in photostat form.

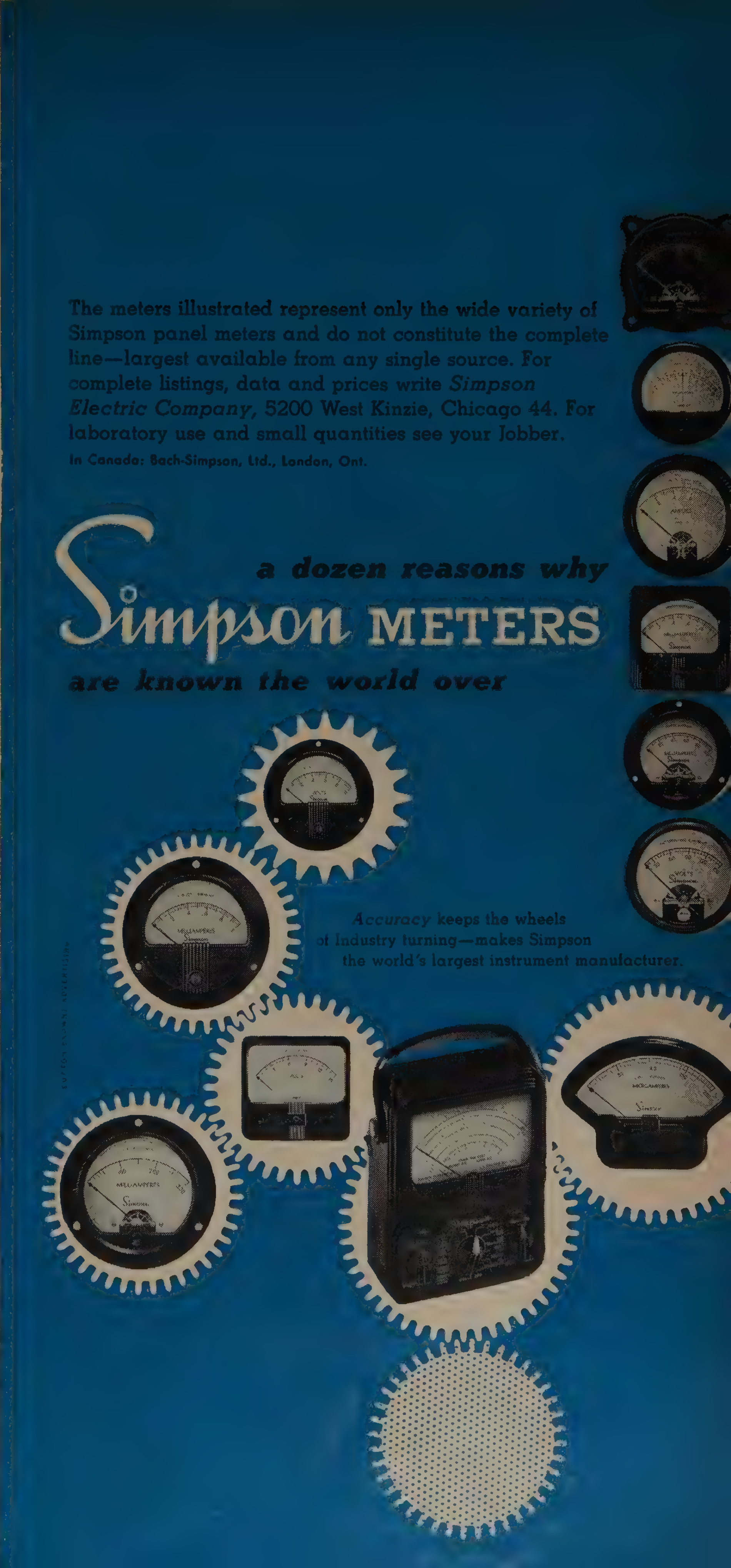
"Portable Radio Assault Beacon," PB 108185, Photoduplication Section, Library of Congress, microfilm, $3, photostat, $8.75.

"Radio Set AN/prc-6," PB 108157, Photoduplication Section, Library of Congress, $2.25, microfilm, and $5, photostat.

"Radio Transmitters, Receivers and Transceivers," PB 73976. Microfilm $9, en-

(*Continued on page 86A*)

Now
PL-4D21
POWER TETRODE
[illegible] DISSIPATION.
FULL RATINGS TO 120 Mc.
HIGH OVERLOAD CAPABILITIES.
AVAILABLE IMMEDIATELY.
For data, Write:
PENTA LABORATORIES INC.
216 North Milpas Street
SANTA BARBARA, CALIFORNIA


The meters illustrated represent only the wide variety of Simpson panel meters and do not constitute the complete line—largest available from any single source. For complete listings, data and prices write *Simpson Electric Company*, 5200 West Kinzie, Chicago 44. For laboratory use and small quantities see your Jobber.
In Canada: Bach-Simpson, Ltd., London, Ont.

a dozen reasons why
Simpson METERS
are known the world over

Accuracy keeps the wheels of Industry turning—makes Simpson the world's largest instrument manufacturer.

Here's a ready answer to your control problems

S.S.WHITE FLEXIBLE SHAFTS

With a single S.S.White remote control flexible shaft unit, it's a simple matter to bring control to any desired point in an electronic circuit. These adaptable, flexible mechanical elements can be run around, over or under intervening parts, need no alignment, and are quickly and easily installed.

S.S.White remote control shafts have been developed specifically for control service. They have the necessary characteristics to provide the quality of control needed for most applications. With proper selection and application, they'll provide any required degree of sensitivity and, once installed, are practically immune from trouble and require no attention.

ENGINEERING COOPERATION

S.S.White engineers are ready to help you work out any proposed flexible shaft applications. Their cooperation is yours without obligation. Write us for details.

GET THE FULL FLEXIBLE SHAFT STORY

Send for the new 256-page S.S.White Flexible Shaft Handbook. It contains complete authoritative information on all phases of flexible shaft selection and application. Copy sent free if you request it on your business letterhead and mention your position.

THE S.S.White INDUSTRIAL DIVISION
DENTAL MFG. CO.
Dept. G, 10 East 40th St.
NEW YORK 16, N. Y.

Western District Office • Times Building, Long Beach, California

Industrial Engineering Notes

(Continued from page 85A)

largement print $82.50. This FIAT microfilm reel consists of manuals for radio transmitters, receivers and transceivers manufactured by the C. Lorenz A. G. for the German Army. It is available at the Photoduplication Section, Library of Congress.

"Rectification of a Sinusoidally Modulated Carrier in Random Noise," PB 108401. Available from Library of Congress, Photoduplication Section, microfilm $2.75, photostat, $7.50.

"Traveling-Wave Tube (discussion of waves for large amplitudes)," PB 108460, Library of Congress, Photoduplication Section, microfilm, $2.25, photostat, $5.

SECTION MEETINGS

AKRON

"The Guided Missile in Technology, War and Civilization," by Robert Mayne, Goodyear Aircraft Corporation; February 24, 1953.

BALTIMORE

"The Keys to the Continent," by C. R. Tatum, Chesapeake & Potomac Telephone Company; March 11, 1953.

BEAUMONT-PORT ARTHUR

"UHF Antenna," by Larry Kearney, La Point-Plascomold Corporation; February 16, 1953.

"Theory and Practical Application T.V. Servicing," by Bob Grow, Sylvania Electric Products; February 25, 1953.

BINGHAMTON

"X-Ray Electronics," by Dr. B. D. Jay, Wilson Memorial Hospital; February 20, 1953.

BUFFALO-NIAGARA

"Some Applications of Information Theory," by Murray Stateman and Michael Leifer; February 18, 1953.

CEDAR RAPIDS

Installation of 1953 officers; January 24, 1953.

"Color Signals and Receivers for Color," by Norman Parker, Motorola; February 18, 1953.

CHICAGO

"New Techniques with Frequency Time Counting," by A. S. Bagley, Hewlett Packard; February 20, 1953.

COLUMBUS

"The Beta Thickness Gage," by George Foster, Industrial Neucleonics Company; February 17, 1953.

"Radio Astronomy," by Prof. J. D. Kraus, Ohio State University; March 10, 1953.

CONNECTICUT VALLEY

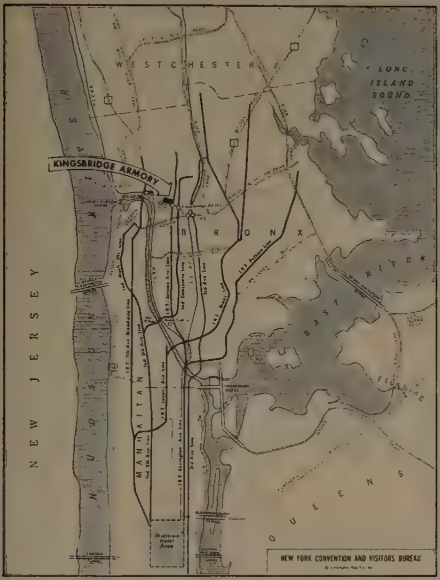
"Switching Circuits for Automatic Control," by W. Keister, Bell Telephone Laboratories; February 19, 1953.

DAYTON

"Electronics in Medicine," by Dr. Stanley Briller, USAF School of Aviation Medicine and Nathan Marshand, Marshand Electronics Corporation; March 12, 1953.

(Continued on page 88A)

KINGSBRIDGE
Our New Exhibition Home
March 22-25, 1954



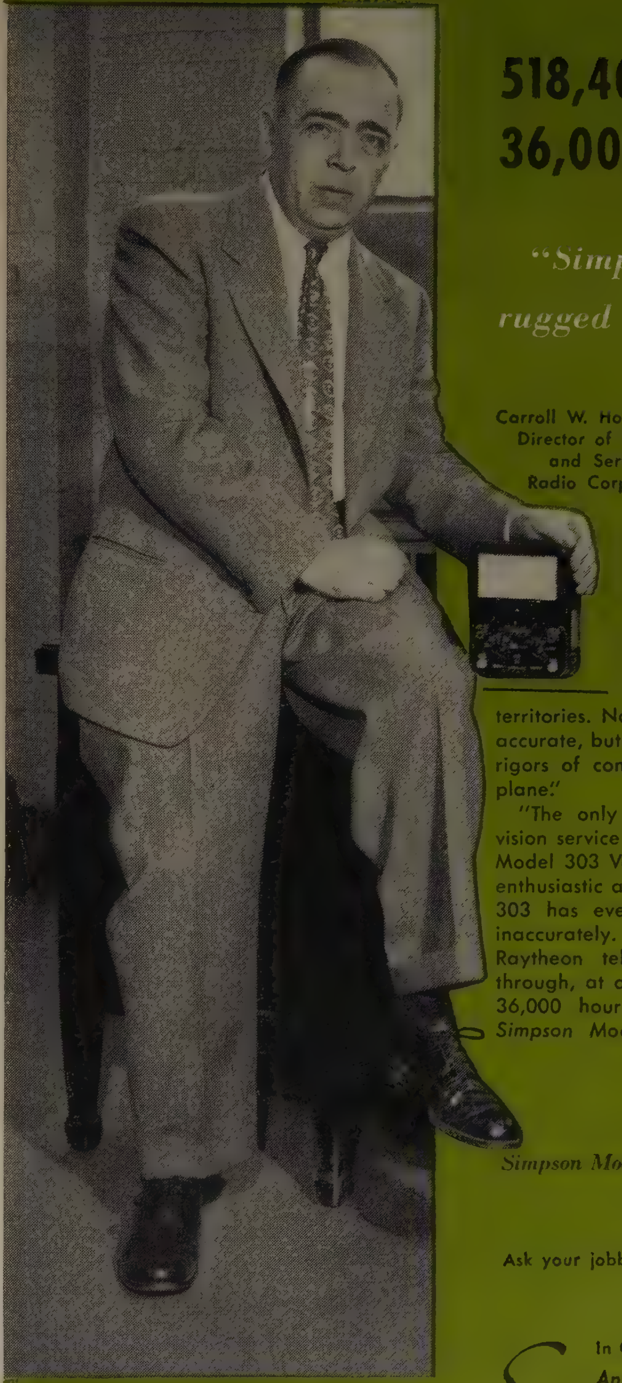
The slogan for the 1953 IRE National Convention was "A Preview of Progress." 1954 is a further step to progress, for the Kingsbridge Armory will prove to be just that. Progress means moving, and moving in this case was the only solution to our problems! Since Grand Central Palace is no longer available as an exhibition hall, the Kingsbridge Armory at Jerome Avenue and Kingsbridge Road, Bronx will be our new Exhibition home March 22nd to 25th, 1954.

Kingsbridge Armory provides a solution to those static elements of Grand Central Palace, which hampered growing firms from having larger exhibits. The Armory will also offer a solution to the 106 manufacturers who have been prevented from exhibiting this year, due to lack of space. As time has progressed, so has the industry. In the last few years, the Electronics industry has made such forward strides that many manufacturers who have entered the Electronics field recently with new developments, have been unable to exhibit them, simply because the Radio Engineering Show had outgrown the four floors of Grand Central Palace. The Kingsbridge Armory will relieve this situation, at least until the Coliseum is built.

The Kingsbridge Armory offers us 86,000 square feet of actual exhibit space in 796 booth units. This represents a gain of over 35% in exhibit space over the usable total in Grand Central Palace. All exhibits are on one floor, which gives us the most democratic type of exhibition. The building is the largest in America under a single suspension roof, and the area is completely free of pillars. The standard 10′x10′ exhibit unit will, therefore, offer the exhibitor maximum economy. Moreover, there are no high walls which require draping. The problem of cluttered and overcrowded aisles will also be alleviated as the aisles will now be widened to 10, 12 and 15 feet. In addition, Kingsbridge has two excellent lecture halls right in the building, seating 720 and 960 people respectively.

Kingsbridge can be reached by taking the IRT express (Jerome Avenue line) from Lexington Avenue and 42nd street to the Kingsbridge Road station. We will also run a constant flow of high-speed, express busses between our headquarters hotel, the Waldorf-Astoria and Kingsbridge Armory.

We are certain that Kingsbridge Armory is a genuine solution to our problems and the 1954 Radio Engineering Show and Convention will be bigger and better than ever.



518,400 MILES
36,000 HOURS

"Simpson Model 303 is too rugged to break!"

Carroll W. Hoshour
Director of Sales Engineering
and Service Raytheon Television and
Radio Corporation

"Nine Raytheon television service representatives are constantly on the road covering 65 distributor territories. Not only must their equipment remain accurate, but it also must be built to withstand the rigors of constant travel by car, train, bus and plane."

"The only test instrument our Raytheon television service representatives carry is the Simpson Model 303 Vacuum Tube Volt-Ohmmeter. We are enthusiastic about this instrument because not one 303 has ever failed to operate or performed inaccurately. The Model 303's in service for Raytheon television representatives have gone through, at a rough estimate, 518,400 miles and 36,000 hours of rigorous handling. *We think Simpson Model 303 is too rugged to break."*

C. W. Hoshour

Simpson Model 303 Vacuum Tube Volt-Ohmmeter
dealer's net $68.9
HV Probe $9.9
RF Probe $7.5

Ask your jobber for full information or write:
Simpson Electric Company
5200 West Kinzie Street
Chicago 44, Illinois CO 1-1221
In Canada: Bach-Simpson, Ltd., London, Ont.

Another reason why
Simpson is the world's largest manufacturer of test equipment

BURTON BROWNE ADVERTISING

full Military Approval *plus* AMPHENOL quality

Amphenol Coaxial Cables set the standard for quality in a field where dependable performance is a "must". Complete RG-/U cables with flexible, low moisture absorbing polyethylene dielectrics plus Teflon dielectric cables for high temperature applications.

Amphenol UG-/U RF Connectors match the efficiency of **Amphenol** Cables—provide excellent impedance match with low RF loss. Available in Types BNC, BN, N, HN, C, LC, Push-On and UHF 83 Series.

Amphenol "AN" Connectors are manufactured in strict adherence to MIL-C-5015 specification. Long recognized as the leader in quality "AN" Connectors, **Amphenol** offers the widest selection available from any single source.

AMERICAN PHENOLIC CORPORATION
chicago 50, *illinois*

For complete information on **Amphenol** *RF Connectors and Coaxial Cables, request Catalog D-2. For "AN" listings and descriptions, request Catalog A-2.*

SECTION MEETINGS

(Continued from page 86A)

Denver

"The Coming Revolution in Engineering Education," by A. M. Stiles, Denver Research Institute, and "The Unusual Properties of Magnetic Amplifiers," by J. E. Kemmerly, Denver Research Institute; February 20, 1953.

Des Moines-Ames

Demonstration and Discussion of R.C.A. Model 1 TV-5, by R. J. Miller, Industrial Sales; February 25, 1953.

"Inside Digital Computers," by F. C. Mullaney, Engineering Research Associates; March 4, 1953.

Detroit

"Telemetering, Instruments and Systems," by M. V. Kiebert, Bendix Aviation Corporation; January 16, 1953.

"What's Happened to Measurements?" by Dr. D. B. Sinclair, General Radio Company; February 20, 1953.

El Paso

"Radio Telescopes and Solar Radio Observations," by D. T. Olmstead, Land-Air Corp., and E. R. Schiffmacher, Solar Radio Observatory; February 12, 1953.

Emporium

"Quality Evaluation of Electron Tubes," by Adolf Warsher, Bendix Corporation; January 27, 1953.

"Radio Chemistry in Semi Conductor Research," by G. H. Morrison, Sylvania Electric Products; February 16, 1953.

Evansville-Owensboro

"Radio Astronomy," by Dr. J. P. Hagen, Naval Research Laboratory and "Clocks," by John Carraway, Jr.; February 18, 1953.

Fort Wayne

"Basis of Atomic Energy," by C. M. Summers, Fort Wayne General Electric; March 5, 1953.

Little Rock

"The Coaxial Cable—Telephone Super Highway," by R. H. Boyd, Southwestern Bell Telephone Company; March 10, 1953.

London

Annual student night: "Wave Guide Construction as applied to UHF Receiver Design," by David Selwyn, Ryerson Institute of Technology; "An Application of Infra Red Radiation," by D. Sharf, Ryerson Institute of Technology; "The Nonlinear Properties of Some Colloidal Solutions," by Art Fullford, University of Western Ontario; "Color T.V. as the F.C.C. Sees It," by B. B. Goodfellow, University of Toronto; February 17, 1953.

"Telemetering Systems and Channels for a Power System," by C. K. Duff, Ontario Hydro Commission; February 24, 1953.

Louisville

"UHF Television Receivers, Design and Experience at Portland, Oregon," by R. Q. Achzehner, Motorola; March 12, 1953.

Miami

"Philosophy of Microwave Equipment Design," by J. R. McKenna, Philco Corporation; February 24, 1953.

"General Applications of Digital Counters," by M. C. Burns, Digital Instrument Company; "Early Days of IRE," by A. H. Lynch, A. H. Lynch & Associates; March 12, 1953.

(Continued on page 89A)

SECTION MEETINGS

(Continued from page 88A)

MILWAUKEE

"Heath Kits, Instruments and Measurements," by Gene Fiebich, Heath Company; February 20, 1953.

NEW MEXICO

Seventh Regional Conference; January 26 and 27, 1953.

NEW YORK

"Radio Astronomy and The Sun," by J. P. Hagen, Naval Research Labs.; February 4, 1953.

OKLAHOMA CITY

"Material and Design Factors in Receiving Tubes," by J. S. Kolp, Sylvania Electric Products; February 17, 1953.

OMAHA-LINCOLN

Tour and Inspection of the Globe Communications Installation and radar control room, conducted by Lt. Col. J. P. Barron, 1911th AACS Squadron; March 2, 1953.

OTTAWA

Students' night: "Thermionic Valves and Their Filaments," by C. Chenier; "The Cathode Ray Oscilloscope," by A. Gagne; "Railway Signalling," by S. Szach; "Frequency Conversion," by P. C. J. Locke; "The L/C Ratio of Tuned Circuits," by G. E. Forman and "Printed Circuits," by F. N. D. Gilbert; February 19, 1953.

Films, "And a Voice Shall be Heard," and "The Royal Visit"; March 12, 1953.

PHILADELPHIA

"The Ultimate in Phonograph Reproduction," by Paul Weathers, Weathers Industries; March 5, 1953.

PITTSBURGH

"Miniaturized Components for Transistor Electronics," by P. S. Darnell, Bell Telephone Labs.; March 9, 1953.

PRINCETON

"How to Guide Guided Missiles," by Dr. W. W. Durding, Johns Hopkins University; February 12, 1953.

ROCHESTER

"Engineering Research at Iowa State College," by Dr. George R. Town, Iowa State College; January 8, 1953.

"Modern High Fidelity Reproduction," by F. H. Slaymaker, Stromberg-Carlson Company; February 13, 1953.

"Theatre Television," by Dr. A. M. Skellett, National Union Radio Corp.; March 5, 1953.

SAN DIEGO

"Super Regulator," by Dr. D. C. Kalbfell, Kalbfell Laboratories, Inc.; election of officers; January 13, 1953.

SAN FRANCISCO

Second annual Symposium on Nuclear Science Instrumentation, Speaker: Herbert Bright, U. S. Naval Radiological Defense; February 18, 1953.

SCHENECTADY

"Magnetic Amplifiers and their Application," by V. J. Louden; General Electric Company; February 9, 1953.

TOLEDO

"Electronic Instrumentation of X-Ray Equipment," by Dr. Jack Ball, Waite Mfg., Division of Picker X-Ray Corp.; March 12, 1953.

TORONTO

Students' Night; February 16, 1953.

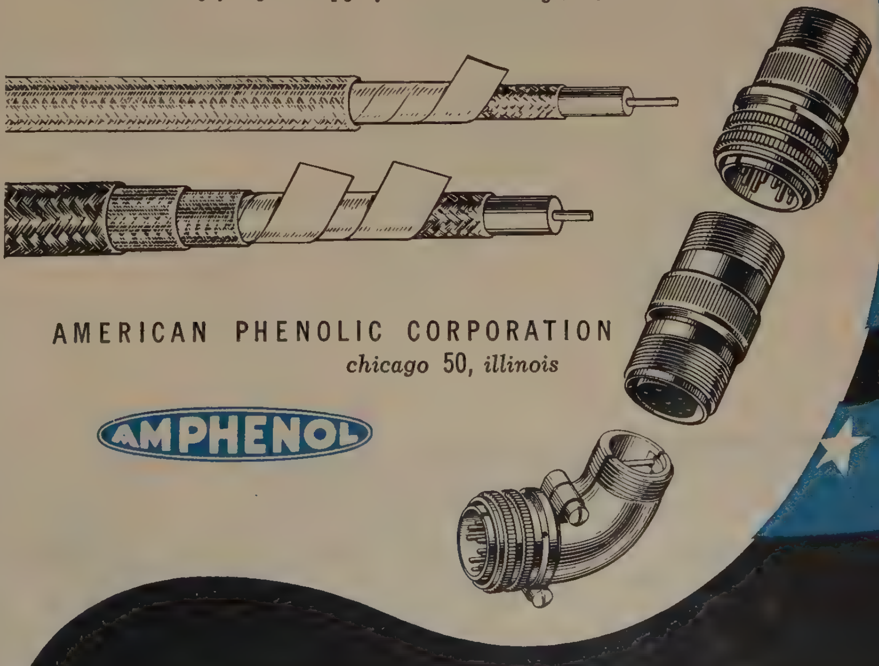
(Continued on page 90A)

back up good design
with
AMPHENOL components

The over 9,000 cataloged items manufactured by AMPHENOL are meant to answer every type of application problem. If your problem is so new or unusual that none of the general types listed below meet your requirements, then consult with AMPHENOL Engineers for the special component you need.

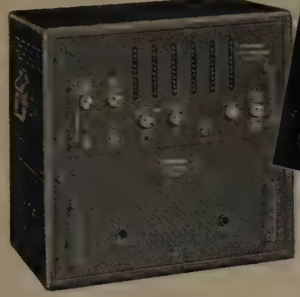
Rack & Panel Type Connectors
AN Type Connectors
RF Type Connectors
Audio Connectors
Power Plugs
Blue Ribbon Connectors
Industrial Sockets
Miniature Sockets
Tube Sockets & Radio Components
Microphone Connectors
RG Coaxial Cables, Teflon & Polyethylene
Cable & Wire Assemblies
Plastics—Extruded & Injection Molded

Write today for your copy of General Catalog B-2.



AMERICAN PHENOLIC CORPORATION
chicago 50, *illinois*

AMPHENOL



* 1 microsecond precision

* high accuracy

* new versatility

Announcing

the New BERKELEY MICROSECOND TIME INTERVAL METER

Model 5120

Description: Model 5120 provides direct reading of elapsed time between any two events, in increments of one microsecond, to a maximum of 1 second. Accuracy is ± 1 microsecond, ± crystal stability (3 parts in 10^6). It consists of a power supply, a 1 megacycle crystal oscillator, an electronic gate with start-stop channels for external control, and six cascaded BERKELEY decimal counting units. The first event "pulse" opens gate, passing 1 megacycle time base signal to counting units. Second event "pulse" closes gate; elapsed time is displayed in microseconds. Input pulses may be either polarity; attenuators permit selection of optimum amplitude. Standard modifications are available to supply marker pulses from slowly changing wave forms to actuate start-stop channels, to extend range and accuracy by factor of 10, to extend total range to 1,000,000 seconds, or to permit use as an electronic counter.

applications: Simplicity of operation and ease of reading make the Model 5120 ideal for both production line and laboratory use for relay and switch timing, accurate measurements of viscosity, elasticity, low frequencies, rates of motion, timing of photographic components, duration of light flashes, and many other applications.

SPECIFICATIONS

RANGE: 3 microseconds to 1 second
ACCURACY: ± 1 microsecond, ± crystal stability (3 parts in 10^6).
POWER REQUIREMENTS: 117 v. (± 10%), 50-60 cycles, 175 watts.
INPUT SIGNALS:
- **START-STOP CHANNELS:** Min. signal 5 v. peak; min. rate of change 20 v., either polarity.
- **PHOTO CHANNEL:** 50 mv. peak sensitivity, direct coupled. 1, 10 and 100 attenuation range.
- **COUNTER INPUT:** 1 v. peak sensitivity.

ACCESSORY SOCKET: Ground; 6.3 v. a.c., 2 a.; 250 v., 20 ma; + 100 v., 10 ma; − 105 v., 5 ma. external reset.
DIMENSIONS, NET WT.: 20¾" wide x 19" high x 15" deep; 110 lbs.
PRICE (F.O.B. RICHMOND): Model 5120, $995.

M-10

For complete information, please request Bulletin 205

Berkeley Scientific

division of BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVENUE • RICHMOND, CALIFORNIA

"DIRECT READING DIGITAL PRESENTATION OF INFORMATION"

SECTION MEETINGS

(Continued from page 89A)

TULSA

"Servomechanism Design and Application," by S. J. Jatras, Midwestern Geophysical Laboratory; February 18, 1953.

TWIN CITIES

"Detecting Pulse Signals in High Noise," by M. R. Doelz, Collins Radio Company, Western Div.; January 27, 1953.

"A New Microwave Relay System," by Nels Johnson, Philco Corporation; February 26, 1953.

WASHINGTON

"Trends in Modern Electronic Navigational Aids," by Cmdr. L. E. Brunner and Cmdr. G. L. Ottinger, both of USCG; March 9, 1953.

SUBSECTIONS

LANCASTER

"Television Interference," by P. S. Rand, Remington Rand; February 11, 1953.

LONG ISLAND

"Electronics in Physiological Research," by Britton Chance, Faculty, University of Pennsylvania; February 10, 1953.

MID-HUDSON

"Ultra-Sonics," by Benson Corlin, Electro Marine Products Company; January 20, 1953.

MONMOUTH

"Special Techniques for Signal Detection in Noise," by M. I. Doelz, Collins Radio Company; January 21, 1953.

NORTHERN NEW JERSEY

"Cold-Cathode, Gas-Filled Tubes for Switching and Control," by M. A. Townsend, Bell Telephone Laboratories, Inc.; February 11, 1953.

ROME

"NTSC Compatible Color Television," by C. J. Hirsch, Hazeltine Corporation; February 24, 1953.

WICHITA

Discussion and Demonstration of television studio camera equipment by H. N. Newby, Chief Engineer, KAKE; February 18, 1953.

STUDENT BRANCH MEETINGS

UNIVERSITY OF AKRON, IRE-AIEE BRANCH

Election of Counselors; February 17, 1953.

"Crystals" by Dr. C. J. Miller, Consultant Engineer for Ohio Brass; March 3, 1953.

UNIVERSITY OF ALBERTA, IRE-AIEE BRANCH

"Aspects of Communications in the Northwest" by Mr. Edgar, Northwest Communication System; February 23, 1953.

"Cost Engineering" by Mr. H. Morrison and Election of Officials; March 9, 1953.

(Continued on page 94A)

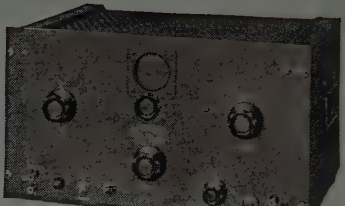
OSCILLATORS

The total coverage of just two of the new *-hp-* oscillators is materially greater than that offered by four previous *-hp-* instruments. For example, new Model 200AB, for general audio tests, offers a wider frequency range of 20 cps to 40 kc and a full watt output. New *-hp-* 200CD, for wide-range measurements at lower power, provides constant voltage output from 5 cps to 600 kc.

In addition to these new instruments, *-hp-* continues to offer Model 200H for carrier current work up to 600 kc, and Model 202D for low frequency and vibration studies down to 2 cps. These instruments retain their time-tested design.

Components, insulation and other electrical and mechanical features are of the highest possible quality. The instruments are carefully adjusted and calibrated to meet exact frequency and performance specifications. An output amplifier provides complete isolation of the load, and changes in the output load cannot change the performance of the oscillator. Frequency stability is better than ±2% including warmup, and hum voltage is less than 0.1% of rated output.

-hp- 202A
Low Frequency Function Generator



This instrument is a compact, convenient and versatile source of transient-free test voltages between 1,000 and 0.01 cps. It provides virtually distortion-free signals for vibration studies, servo application, medical and geophysical work and other subsonic and audio problems. The equipment generates 3 wave forms—sine, square and triangular. Output is 30 volts peak-to-peak for all wave forms. The output system is fully floating with respect to ground and may be used balanced or single-ended. The instrument will deliver 10 volts RMS to a 2,500 ohm load; internal impedance, however, is only 40 ohms. There are no coupling capacitors in the output system, and a high degree of dc balance is achieved by a special circuit. Price, $450.

BRIEF SPECIFICATIONS—200 SERIES OSCILLATORS

-hp- MODEL	FREQUENCY RANGE	BANDS	FREQUENCY RESPONSE	POWER OUTPUT	LOAD IMPEDANCE	DISTORTION	POWER CONSUMPTION	PRINCIPAL APPLICATIONS	PRICE
200AB	20 cps to 40 kc	4 ranges	± 1 db Ref. 1 kc	1 watt or 24.5 v	600 ohms	1%	60 watts	Audio Tests	$120.00
200CD	5 cps to 600 kc	5 ranges	± 1 db Ref. 1 kc	160 mw — 600 ohms or 20 volts open circuit*		1%	75 watts	Audio, Ultrasonic, tests	$150.00
200H	60 cps to 600 kc	4 decades	± 1 db Ref. 1 kc	10 mw or 1 v	100 ohms	1%, 100-100,000 cps 3%, 60-600,000 cps	115 watts	Carrier Current & Telephone Tests	$350.00
202D	2 cps to 70 kc	5 ranges	± 1 db Ref. 1 kc	100 mw or 10 v	1,000 ohms	1%	80 watts	Low Frequency Measurement	$275.00
200I	6 cps to 6 kc	6 ranges	± 1 db Ref. 400 cps	100 mw or 10 v	1,000 ohms	1% 10-6,000 cps	115 watts	Interpolation and Frequency Measurement	$225.00

(*Internal impedance 600 ohms.) Data subject to change without notice. Prices f.o.b. factory.

HEWLETT-PACKARD COMPANY
Field Engineers in Principal Cities
2523D PAGE MILL ROAD • PALO ALTO, CALIFORNIA

hp INSTRUMENTS – Complete Coverage!

SENSITIVITY—ACCURACY—STABILITY

make **BALLANTINE**

The World's Leading Electronic Voltmeters

AUDIO TO 150 KC **Model 300**

1 mv—100 v	Voltage Range
10 cps—150 kc	Frequency Range
2% ENTIRE RANGE	Accuracy
½ meg. shunted by 30 μμf	Input Impedance

SUB-AUDIO TO 150 KC [Battery Operated] **Model 302B**

100 μv—100 v	Voltage Range
2 cps—150 kc	Frequency Range
3% 5 cps—100 kc 5% 2 cps—5 cps 100 kc—150 kc	Accuracy
2 meg. shunted by 15 μμf*	Input Impedance

AUDIO TO 2 MC **Model 310A**

100 μv—100 v	Voltage Range
10 cps—2 mc	Frequency Range
3% to 1 mc 5% 1 mc—2 mc	Accuracy
2 meg. shunted by 15 μμf*	Input Impedance

AUDIO TO 6 MC **Model 314**

1 mv—1000 v (100 uv—1 mv without probe)	Voltage Range
15 cps—6 mc	Frequency Range
3% to 3 mc 5% 3 mc—6 mc	Accuracy
11 meg. shunted by 6 μμf (1 meg. shunted by 25 μμf without probe)	Input Impedance

PEAK-TO-PEAK **Model 305**

1 mv—1000 v pk-to-pk	Voltage Range
10 cps—100 kc (Sine Wave)	Frequency Range
3 μsec—250 μsec	Pulse Width
20 pulses per sec.	Min. Rep. Rate
5% for pulses	Accuracy
2 meg. shunted by 15 μμf*	Input Impedance

*Shunt capacitance is 8 μμf on all ranges except two most sensitive ranges.

Write for complete catalog of all Ballantine Electronic Instruments

BALLANTINE LABORATORIES, INC.

102 Fanny Road, Boonton, N.J.

STUDENT BRANCH MEETINGS

(*Continued from page 90A*)

CALIFORNIA STATE POLYTECHNIC COLLEGE, IRE BRANCH

"Data Processing Systems: The Systems Engineering Approach to the Automatic Data Handling Problem" by Mr. Robert L. Sink, Consolidated Engineering Corp.; March 12, 1953.

UNIVERSITY OF COLORADO, IRE-AIEE BRANCH

"New Developments in Telephone Communications" by Mr. R. M. Bolt, Mountain States Telephone Company; February 11, 1953.

"Switchgear" by Mr. R. F. Carr, Westinghouse Electric Corp. and Election of Faculty Advisors; February 25, 1953.

COLUMBIA UNIVERSITY, IRE-AIEE BRANCH

"Opportunities in Communications & Power" by Mr. John W. Balet, Consolidated Edison and Mr. L. M. Gambrill, Bell Telephone Laboratories; March 3, 1953.

UNIVERSITY OF CONNECTICUT, IRE-AIEE BRANCH

General Meeting; March 11, 1953.

UNIVERSITY OF DETROIT, IRE-AIEE BRANCH

"Fuses" by Mr. Pardee, Detroit Edison Co.; February 18, 1953.

GEORGE WASHINGTON UNIVERSITY, IRE BRANCH

Motion Pictures on Application of Electric Motors; March 4, 1953.

STATE UNIVERSITY OF IOWA, IRE BRANCH

"After College—What Then?" by Prof. E. B. Kurtz, Faculty S.U.I. and Election of Officers; February 18, 1953.

"Student Papers Contest" and "Experience in Industry" by Mr. James L. Westcot, Chairman Student Branch IRE; February 25, 1953.

"Hydraulic Transmissions and Torque Converters" by Mr. E. M. Sharar, General Motors Engineer; March 4, 1953.

"Transistors and their Circuit Applications" by Mr. Finch, Bell Telephone Laboratories; March 11, 1953.

KANSAS STATE COLLEGE, IRE BRANCH

"Electron Tube Development" by Mr. Wallace M. James, R.C.A., Harrison, N. J.; February 19, 1953.

"Practical Applications of Engineering" by R. R. Jenner, Beech Aircraft Corp.; March 5, 1953.

UNIVERSITY OF KANSAS, IRE-AIEE BRANCH

"Methods of Electrical Measurement" by H. Berring, Weston Electrical Instrument Corp.; February 25, 1953.

LEHIGH UNIVERSITY, IRE BRANCH

"Some Applications of Servomechanisms" by Winslow Palmer, Sperry Gyroscope Company; January 8, 1953.

"Switching Techniques" by W. O. Fleckenstein, Bell Telephone Laboratories, N. Y.; February 19, 1953.

MARQUETTE UNIVERSITY, IRE-AIEE BRANCH

General Meeting; January 22, 1953.

General Meeting and Election of Officers; February 12, 1953.

UNIVERSITY OF MARYLAND, IRE-AIEE BRANCH

"Digital & Analog Computers" by Dr. George Petrie, International Business Machines Co.; March 4, 1953.

(*Continued on page 96A*)

circuit engineers! transistor manufacturers!

an unexcelled

TRANSISTOR TEST SET

A Precision Laboratory Instrument to test small signal behavior of all POINT CONTACT and JUNCTION TRANSISTORS

TRANSISTOR TEST EQUIPMENT—Model T-61 measures four independent parameters of the four terminal equivalent circuit of the transistor. These measurements can be carried out over the complete operating range of the transistor, and thus directly lead to the quantitative data necessary for circuit design.

Its function in the transistor field is comparable to that of a vacuum tube bridge in the vacuum tube field, but much simpler to operate since it is a direct reading.

FLEXIBILITY—COMPLETENESS insure continued maximum usefulness in anticipation of the development of new types of transistors.

PRICE—$2,150.00 F.O.B. BOSTON

Overall accuracy is 2%. The unit contains separate metering circuits for all applied D.C. currents and voltages, a precision vacuum tube volt-meter for direct reading of the parameters under test, and a precision single frequency audio-oscillator. It is powered by 8 separate self-contained regulated power supplies, facilitating operation without adjustment over all normal line voltage variations.

CONTACT OUR NEAREST REPRESENTATIVE FOR FURTHER INFORMATION

Albuquerque, New Mexico
Gerald B. Miller Company
302½ West Central Avenue
Albuquerque 3-1998

Alexandria, Virginia
W. A. Brown & Associates
3834 Mt. Vernon Avenue
Overlook 6100

Atlanta, Georgia
W. A. Brown & Associates
1570 Northside Drive
Vernon 5395

Boston, Mass.
Burlingame Associates
270 Commonwealth Avenue
Kenmore 6-8100

Chicago 45, Illinois
Hugh Marsland & Company
6405 North California Avenue
Ambassador 2-1555

Cleveland 15, Ohio
M. P. Odell Company
2536 Euclid Avenue
Prospect 1-6171

Dallas 1, Texas
J. Y. Schoonmaker Co.
2011-13 Cedar Springs
Sterling 3335

Dayton 6, Ohio
M. P. Odell Company
2676 Salem Avenue
Oregon 4441

Hollywood 28, California
Gerald B. Miller
1540 N. Highland Avenue
Hollywood 9-6305

New York 13, New York
Burlingame Associates
103 Lafayette Street
Digby 9-1240

San Francisco 3, California
Gerald B. Miller Company
1355 Market Street, Space 280D
Klondike 2-2311

OPERATIONAL CHARACTERISTICS:

D.C. BIAS CONDITIONS OF EITHER POLARITY ARE PROVIDED IN THE FOLLOWING RANGES:

Emitter current	0—15 milliamperes
Collector current	0—15 milliamperes
Collector voltage	0—100 volts reg.

Write to TRANSISTOR PRODUCTS *Now for Detailed Information*

TRANSISTOR PRODUCTS INC.

Snow and Union Sts.
Brighton Station, Boston 35, Mass.
An operating unit of the CLEVITE Corp.

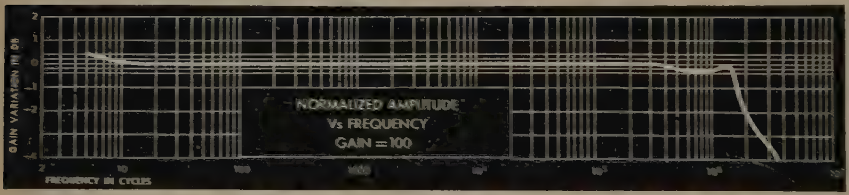
Technology Instrument Corp. Presents a Compactly-Built Wide-Band Decade Amplifier

Featured by its wide band response, high input impedance, low output impedance, and compact dimensions, TIC's Type 500-A wide band decade amplifier is excellent as a general purpose laboratory instrument. Here is an instrument for special applications requiring a zero phase shift and high stability of gain. TIC increases the general utility of this amplifier by including a self-contained power supply and cabinet or rack mounting.

SPECIFICATIONS:

Amplification : 10, 100 and 1000 times, selected by 3-position rotary switch.

Frequency Response: Flat to ± .5 db from 5 cycles to 2 mc on gain of 10; Flat to ± .5 db from 5 cycles to 1.5 mc on gain of 100; Flat to ± .8 db from 5 cycles to 1 mc on gain of 1000.



Amplification Accuracy: ± 2% of nominal — dependent on precision resistors only; Unaffected by normal tube characteristics or line variations.

Phase Shift on All Ranges: 0 to ± 2° from 20 cycles through 100 kc

Gain Stability on All Ranges: Constant with line voltages of 105 to 124 volts.
Noise and Hum: 60 db below maximum output voltage with input shorted.
Input Impedance: Approximately 160 megohms shunted by 7 $\mu\mu f$.

Output Impedance: Approximately 200 ohms.

Output Voltage on All Ranges: 20 volts maximum output across a load of 20 kΩ or greater.

Power Supply: 105-125 volts, 50-60 cycles self-contained power supply requiring approx. 30 watts. (230 volt, 50-60 cycles models available).

Mounting Dimensions: Single, in cabinet: 13¼" wide x 5" high x 9⅜" deep. (11¼" x 3½" panel) Single, for rack: 19" wide x 3½" high x 8½" deep.

The low distortion is a feature much desired in amplifiers of this type.

Further information and details gladly sent upon request.

Engineering Representatives

Chicago, Ill. — UPtown 8-1141
Cleveland, Ohio — PRospect 1-6171
Waltham, Mass. — WAltham 5-6900
Boonton, N. J. — Boonton 8-3097
Dayton, Ohio — Michigan-8721

Arnprior, Ont., Can. — Arnprior 400
New York, N. Y. — Murray Hill 8-5858
Hollywood, Cal. — HOllywood 9-6305
Dallas, Texas — DIxon 9918

TECHNOLOGY INSTRUMENT CORP.

535 Main Street, Acton, Massachusetts, Telephone: Acton 600

STUDENT BRANCH MEETINGS

(Continued from page 96A)

Ohio State University, IRE-AIEE Branch

Business Meeting and Films "Yellowstone National Park" and "Korean Battleground"; February 26, 1953.

"Military Necessities of Recording Equipment" by John D. Sullivan, Signal Corps Engineering Labs.; March 12, 1953.

Rensselaer Polytechnic Institute, IRE-AIEE Branch

"Excursion in Electronics" by Cyril N. Hoyler, RCA Laboratories; March 17, 1953.

Rutgers University, IRE-AIEE Branch

Panel Discussion: "Purpose of Engineering Education" by D. G. Moore, RCA Laboratories, W. Frederick, Allied Allegri Machine Company, W. White, Ballantine Laboratories; February 19, 1953.

Election of Officers and Election of Faculty Advisors; February 24, 1953.

"Aspects of Geophysical Prospecting using Electrical and Magnetic Measurements" by B. L. Smith, Lecturer of Geology at Rutgers University; March 5, 1953.

San Diego State College, IRE Branch

"Servo-Control Systems" by Richard Silberman, Kalbfell Laboratories; February 26, 1953.

Seattle University, IRE Branch

Business Meeting; January 14, 1953.

Films, "Rotating Magnetic Fields," and "Basic Principles of Frequency Modulation"; February 12, 1953.

South Dakota School of Mines and Technology, IRE Branch

General Business Meeting; February 12, 1953.

University of Southern California, IRE-AIEE Branch

General Business Meeting; February 18, 1953.

Stanford University, IRE-AIEE Branch

"Microwave Techniques" by Robert E. Barrington, Pacific Telephone & Telegraph; March 4, 1953.

University of Texas, IRE-AIEE Branch

"Hydro-Electric Development" by C. L. Dowell, Hydraulic Engr. Lower Colorado River Authority, March 2, 1953.

"University Student Union Expansion at the Univ. of Texas" by C. C. Nolen, Director, University Student Union; March 16, 1953.

Tufts College, IRE-AIEE Branch

"Power Distribution" by Mr. L. J. We d Boston Edison Power Co.; March 3, 1953.

Utah State Agricultural College, IRE Branch

"Patent Rights" by James A. Hardman, Utah Research Foundation; February 25, 1953.

Virginia Polytechnic Institute, IRE-AIEE Branch

"New Developments in the Navy" by Dr. E. D. Harrison, Faculty, Virginia Polytechnic; February 17, 1953.

"Security and the Engineer" by Prof. George Barnes, Faculty, Virginia Polytechnic; February 24, 1953.

(Continued on page 100A)

Military Equipment Builders:

INSTALL HIGH-RELIABILITY TUBES, FOR BETTER PRODUCT ACCEPTANCE!*

*For example, the United States Navy has recognized the value of high-reliability tubes by authorizing a detailed list of these types to replace standard-tube counterparts. "Tele-Tech", March, 1953.

Now available in quantity!

General Electric high-reliability tubes, carrying the famous 5-Star name, now are available in quantity. To get all the advantages that high-reliability types offer you—greatly increased equipment dependability, lower maintenance costs, longer tube life—specify G-E 5-Star Tubes!

A pioneer in designing and developing these premium types, General Electric gives you *tube quality* that only experience makes possible. As the largest builder of high-reliability tubes, with outstanding manufacturing facilities, G.E. offers you *the widest choice* of types, plus *high-rate production* to meet your needs.

Acceptance of the equipment you design and build will increase, once you change over to 5-Star high-reliability tubes. Field performance will be far more dependable, enhancing your reputation. Write now for Booklet ETD-548A, which contains full 5-Star Tube application information! *General Electric Company, Tube Department, Schenectady 5, N. Y.*

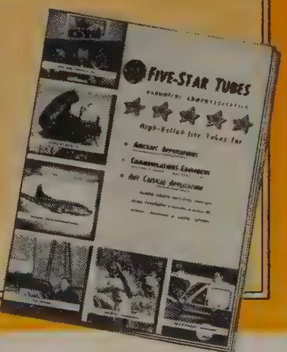
Meet your circuit needs from these 30 premium-performance tubes!

PROTOTYPES	HIGH-RELIABILITY TUBES	
	Military Type No.	**Description**
2C51	*5670	H-f medium-mu twin triode
2D21	5727	Thyratron
5Y3-GT	5Y3WGTB (RTMA 6087)	Full-wave rectifier
6AC7	6AC7WA (RTMA 6134)	Sharp-cutoff r-f pentode
6AK5	5654	Sharp-cutoff r-f pentode
6AL5	5726	Twin diode
6AQ5	6005	Beam power amplifier
6AS6	5725	Dual-control sharp-cutoff r-f pentode
6AU6	6AU6WA (RTMA 6136)	Sharp-cutoff pentode
6BA6	5749	Remote-cutoff r-f pentode
6BE6	5750	Pentagrid converter
6C4	*6135	Medium-mu triode
6SK7	6SK7WA (RTMA 6137)	Remote-cutoff r-f pentode
6X4	**Not assigned (RTMA 6202)	7-pin full-wave rectifier
——	Not assigned (RTMA 6203)	9-pin full-wave rectifier
12AT7	12AT7WA (RTMA 6201)	High-Gm high-mu twin triode
12AU7	*5814-A	Medium-mu twin triode
12AX7	*5751	High-mu twin triode
12AY7	*6072	Low-noise high-mu twin triode
——	5686	Beam power amplifier

*Draws 1/6 more heater current. **Rated at 50 ma output current.

HIGH-RELIABILITY SUBMINIATURES

Military Type No.	Description
5718	Medium-mu triode
5719	High-mu triode
5797	Semi-remote-cutoff pentode
5798	Medium-mu twin triode
5840	Sharp-cutoff r-f pentode
5896	Twin diode
5899	Semi-remote-cutoff pentode
5902	Beam power amplifier
6111	Medium-mu twin triode
6112	High-mu twin triode



GENERAL ELECTRIC

1878 75 1953
YEARS OF ELECTRICAL PROGRESS
Diamond Anniversary

163-1A5

CANNON PLUG ACCESSORIES
for the "AN" Series

Here is the answer to a frequent question we receive from people everywhere. Yes, Cannon *does* make a complete line of accessories to be used in conjunction with the AN Series of connectors. Complete engineering data on each of these is given in the Cannon AN Bulletin, available on request.

CANNON ELECTRIC
Since 1915

Factories in Los Angeles, Toronto, New Haven Representatives in principal cities. Address inquiries to Cannon Electric Co., Dept. E-377, Los Angeles 31, California

STUDENT BRANCH MEETINGS

(Continued from page 98A)

UNIVERSITY OF WASHINGTON, IRE-AIEE BRANCH

"Problems of Designing a Power Utility" by E. C. Starr, Faculty, Oregon State College; February 11, 1953.

WORCESTER POLYTECHNIC INSTITUTE, IRE-AIEE BRANCH

"Inventions and Patent Law" by Walter Wakefield, Crompton and Knowles Co., Worcester; February 26, 1953.

"Ten to Twenty Years after Graduation—What?" by R. E. Kendall, Motorola Communications and Electronics Inc.; March 17, 1953.

UNIVERSITY OF WYOMING, IRE-AIEE BRANCH

"Impregnated paper Insulated Cables" (Film) and General Meeting; January 27, 1953.

YALE UNIVERSITY, IRE-AIEE BRANCH

"Comparison and Duality Between Motion Pictures and Television" by Otto H. Schade, RCA staff engr.; February 19, 1953.

MEMBERSHIP

The following transfers and admissions were approved to be effective as of May 1, 1953:

Transfer to Senior Member

Allison, W. M., Sprague Electric Co., North Adams, Mass.
Brady, P. B., 7416 Rugby St., Philadelphia 38, Pa.
Brotzman, E. S., 611 Lees Ave., Collingswood 7, N. J.
Burns, R. C., 81 Winter La., Hicksville, L. I., N. Y.
Byers, A. C., Franklin Institute Laboratories for Research and Development, Philadelphia 3, Pa.
Dean, N. J., Laboratory for Electronics, 75 Pitts St., Boston 14, Mass.
Di Marco, A., Fray Cayetano 240, Buenos Aires, Argentina
Fellers, R. G., 3812 Nash St., S.E., Washington 20, D. C.
Gannett, E. K., 400 Fairview Ave., Fort Lee, N. J.
Gould, G. T., Jr., 412 Lonsdale Ave., Dayton 9, Ohio
Grebenkemper, C. J., 3683 Highwood Dr., S.E., Washington 20, D. C.
Grosvenor, A. C., Chesapeake Beach, Md.
Hopkins, A. F., Jr., Box 128, R.F.D. 3, Alexandria, Va.
Howard, W. A., c/o National Broadcasting Co., 815 Superior Ave., Cleveland 14, Ohio
Hunter, R. P., 859 N. Allen St., State College, Pa.
James, W. G., 131 Marietta Cir., Oak Ridge, Tenn.
Johnston, S. L., 207 Edgewood Dr., Huntsville, Ala.
Kaushagen, W. M., 408 McKinley Ave., Kenmore 23, N. Y.
Levinthal, E. C., 14806 Oxnard St., Van Nuys, Calif.
Lindner, H. G., 41 John St., Red Bank, N. J.
Loughlin, B. D., Hazeltine Corp., 58-25 Little Neck Pkwy., Little Neck, L. I., N. Y.
Meisenheimer, R. L., Kay Drive E., Haddonfield, N. J.

(Continued on page 101A)

NEW RECORDING PAPER

For the first time there is available an indelible recording paper—ALFAX—that is NOT subject to humidity, temperature or capillary action problems usually associated with pen and ink or papers marked by arcing or heat.

ELECTRICITY IS THE INK THAT MARKS ALFAX

Alfax paper can be marked by one volt and is instantaneous, permanent and stable. Highly sensitive Alfax is capable of catching transients and has a tone response capable of fourteen steps by simply varying the current through the paper.

Alfax is the only paper that is capable of high speed recording, stable before or after recording, is non-transferable, has low current consumption at high speeds, can record at high humidity over all temperature ranges, is smudge proof and non-toxic.

Alfax opens a whole new field of monitoring and recording of phenomena which never before have been done easily and cheaply.

Send for literature and send us your recording problem. We will be happy to work with you.

ALFAX PAPER & ENGINEERING COMPANY
P.O. Box 125, Westboro, Massachusetts

The RIGHT Coated Fabric for YOU

Over the years, leading manufacturers have learned to rely upon APEX when selecting durable, fast colored, sales-improving fabrics for:

PORTABLE PHONOGRAPHS
PORTABLE RADIOS
TAPE RECORDERS
TV BOOSTERS
SERVICING KITS
ANTENNA ROTATOR CONTROL CABLES
SERVICEMEN'S CARRYING CASES
PORTABLE PA SYSTEMS
PORTABLE TV SETS
TEST INSTRUMENTS
SOUND & PROJECTION EQUIPMENT
INDUSTRIAL & MEDICAL EQUIPMENT

It will cost you nothing to let APEX specialists consider your problems.

APEX COATED FABRICS TRADE MARK REG.

APEX COATED FABRICS, Inc.
16 East 22nd St. N.Y. City 10
Phone: SPring 7-3140

For 27 years "The House of Service"

(*Continued from page 100A*)

Morgan, R. B., 529A Allenhurst Rd., Buffalo 23, N. Y.
Olson, R. W., 6307 Woodland, Dallas 5, Tex.
Reynolds, R. H., Jr., 202 Highland Ave., Syracuse 3, N. Y.
Robel, R. B., 9931 Brookmoor Dr., Silver Spring, Md.
Roschke, E. M., 372 Stratford Rd., Des Plaines, Ill.
Rosenberg, S., 907 Valentine Ave., Rome, N. Y.
Sakamoto, T., Electrical Engineering Department, University of Tokyo, Bunkyo-ku, Tokyo, Japan
Sherwood, R. M., 4512 Del Mar Ave., San Diego 7, Calif.
Swarthe, E., 208—42 St., Manhattan Beach, Calif.
Tooker, H. A., 2524 Fairview St., Allentown, Pa.
Vacca, R. H., 45 Thornton Rd., Waltham, Mass.
Young, J. D., 1504 Vee St., S.E., Washington 20, D.C.
Witten, A. L., 20 Evelyn Rd., Port Washington, L. I., N. Y.

Admission to Senior Member

Algeo, B. C., Jr., Solebury, Bucks County, Pa.
Beltz, W. H., Wardman Park Hotel, Washington, D. C.
Benjamin, J. N., 69-26–175 St., Flushing 65, L. I., N. Y.
Boyajian, A., 55 Stratford Ave., Pittsfield, Mass.
Brown, G. S., Rm. 4-202, Electrical Engineering Department, Massachusetts Institute of Technology, Cambridge 39, Mass.
Cunningham, R. F., R.F.D. 1, Spring Valley, Ohio
Darlington, S., Bell Telephone Labs., Murray Hill, N. J.
Davis, P. D., Jr., 3001 Bonita Dr., Garland, Tex.
Demetrick, J. S., 84 Roosevelt Rd., Medford 55, Mass.
Glancy, R. C., Jr., Rm. 1307, 100 William St., New York 38, N. Y.
Grosch, H. R. J., Bldg. 300, General Electric Co., Cincinnati 15, Ohio
Harris, W. T., The Harris Transducer Corp., Box 477, Southbury, Conn.
Kahal, R., U. S. Naval Post Graduate School, Monterey, Calif.
Kelly, D. A., 4638 Tenth Ave., Los Angeles 43, Calif.
Ku, Y. H., 200 South 33 St., Philadelphia 4, Pa.
Lartaud, H. R., 44 Lake Ave., Fair Haven, N. J.
Leitner, R. G., 2550 S. Barrington Ave., Los Angeles 64, Calif.
McNaney, J. T., Box 324, Hilcrest Station, San Diego 3, Calif.
Nelson, C. R., 219 Pennypack Cir., Hatboro, Pa.
Olson, R. H., 4422 E. Flower St., Phoenix, Ariz.
Rankin, R. L., 435 West 119 St., New York 27, N. Y.
Rothlein, B. J., 602 Garner Pl., East Meadow, L. I., N. Y.
Rush, S., 900 N. George, Rome, N. Y.
Smith, R. O., 1235 B. Glebe Rd., Arlington 1, Va.
Sponable, E. I., Twentieth Century-Fox Film Corp., 460 West 54 St., New York 19, N. Y.
Stuart, J. F., Box 991, El Paso, Tex.
Timberlake, F. A., American Broadcasting Co., 20 N. Wacker Dr., Chicago 6, Ill.
White, W. E., Apt. 505, 260 Metcalfe St., Ottawa, Ont., Canada
Woo, W. D., 26 Longfellow Rd., Arlington 74, Mass.
Woodward, R. W., Underwood Corp., 56 Arbor St., Hartford 6, Conn.
Ziegler, A. W., 47 Meadowbrook Rd., Short Hills, N. J.

Transfer to Member

Altman, S. S., 4111 N. Fourth St., Arlington 3, Va.
Arnstein, P. B., 5944 LeMay Rd., Rockville, Md.
Athersych, F. B., 713 King St., London, Ont., Canada

(*Continued on page 102A*)

STABLE AS A Wirewound RESISTOR*

SIE

MODEL "R" VOLTMETER

• DC VOLTS • DC MILLIVOLTS
• AC VOLTS • AC MILLIVOLTS
• STANDARD CELL • DC AMPLIFIER
• OHMS — MEGOHMS

THE MODEL "R" VOLTMETER

The Model "R" is primarily intended for the precise measurement of DC potentials, providing DC voltage ranges from one volt full scale to 1,000 volts full scale; however, to allow the instrument its greatest possible utility, the following auxiliary functions have been included in its design.

Distended DC Voltage Ranges: Bucks out 99% of measured voltage and indicates 1% of measured voltage full scale.

DC Millivolt Ranges: One millivolt full scale to 1,000 millivolts full scale.

AC Volt and Millivolt Ranges: One Millivolt full scale to 1,000 volts full scale from 10 cps to 100 kc.

Self-Contained Standard Cell: For instant check of voltmeter calibration.

Ohms Ranges: Times one to times 10^6.

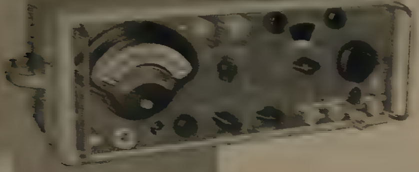
Distended Ohms Ranges: Reads bottom half of ohms scale full scale.

DC Amplifier: Will drive a one ma recorder, has gain of 200, and frequency range of zero to 100 kc.

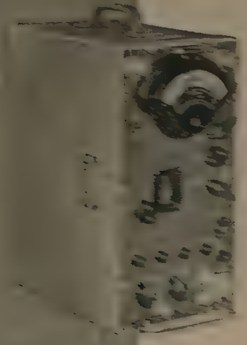
*This statement refers to the fact that precision wire-wound resistors are used for all attenuators and range resistances, and that the DC Amplifier is a highly degenerative system employing wire-wound resistors for the beta network. It has been found that changes in gain with warm-up are in the order of .1 of 1% and are primarily due to the temperature coefficient of the resistors in the beta network.

SOUTHWESTERN INDUSTRIAL ELECTRONICS COMPANY

STANDARD
Radio Interference and Field Intensity
MEASURING EQUIPMENT
Complete Frequency Coverage—14kc to 1000 mc!



VLF
14kc to 250kc
Commercial Equivalent of AN/URM-6B.
Very low frequencies.



HF
150kc to 25mc
Commercial Equivalent of AN/PRM-1A. Self-contained batteries. A.C. supply optional. Includes standard broadcast band, radio range, WWV, and communications frequencies. Has B.F.O.

VHF
15mc to 400mc
Commercial Equivalent of TS-587 U.
Frequency range includes FM and TV Bands.

UHF
375mc to 1000mc
Commercial Equivalent of AN URM-17.
Frequency range includes Citizens Band and UHF color TV Band.

These instruments comply with test equipment requirements of such radio interference specifications as MIL-I-6181, MIL-I-16910, PRO-MIL-STD-225, ASA C63.2, 16E4, AN-I-24a, AN-I-42, AN-I-27a, MIL-I-6722 and others.

STODDART AIRCRAFT RADIO Co., Inc.
6644-C Santa Monica Boulevard, Hollywood 38, California

MEMBERSHIP

(Continued from page 101A)

Baldwin, C. O., 72 De Vere Gardens, Toronto 12, Ont., Canada
Balkanli, H., Muhabere Ana Depo Ve. Fabrikasi Teknik Muduru, Ankara, Etlik, Turkey
Ballard, D. C., 146 Old Dorwart, Lancaster, Pa.
Bernbaum, L. M., Manheim Gardens, Apt. 16A, Philadelphia, Pa.
Berner, A. S., 158 Harvard St., Dorchester 24, Mass.
Book, E. G., 1503 Elm St., Valparaiso, Ind.
Burkhard, F. J., 779 Clark Ave., Los Altos, Calif.
Carretta, P. M., Rm. 1B410, Bell Telephone Laboratories, Inc., Murray Hill, N. J.
Chapman, C. I., Chief Radio Engineer, Sendai FEN, APO 547, c/o Postmaster, San Francisco, Calif.
Courtney, R. H., Jr., 2004 Oak Ave., Newport News, Va.
Donsbach, W. R., 1617 Sulphur Spring Rd., Baltimore 27, Md.
Elliott, A. W. D., 105 Parkview Ave., Willowdale, Ont., Canada
Fingado, F. H., 611–17 St., Denver 2, Colo.
Ford, H. P., Jr., Civilian Mail Room, APO 994, c/o Postmaster, San Francisco, Calif.
Fujiki, S., 1-73, Shim-machi, Setagaya-Ku, Tokyo, Japan
Glantz, L. M., 909 Avenue T, Brooklyn 23, N. Y.
Green, M. W., 175 Union Ave., Rutherford, N. J.
Hanik, P., 2309 West 50 St., Chicago 9, Ill.
Horton, W. H., Rose Ave., Schenectady 3, N. Y.
Kahn, H., 65 Harvard St., Roslyn Heights, L. I., N. Y.
Kaiser, J. A., Jr., 10408 Detrick Ave., Kensington, Md.
Kelly, R. W., 3708 Park La., Dallas, Tex.
Kern, J. I., 368 Central Park Ave., Dayton 9, Ohio
Love, S. F., 189 Dufferin St., Toronto 3, Ont., Canada
Miller, E. O., 345 South St., Morristown, N. J.
Mudry, J., 4 E. Haven Dr., Toronto 13, Ont., Canada
Stalford, W. E., Bendix Aviation Corp., 11600 Sherman Way, North Hollywood, Calif.
Swanson, W. V., 4232 Corinth Blvd., Dayton 10, Ohio
Swern, L., Sperry Gyroscope Co., D-40, Great Neck, L. I., N. Y.
Totah, E. J., 962 Wayne Ave., Silver Spring, Md.
Turner, W., 358 Pemberton Rd., Rochester 9, N. Y.
Warfield, J. N., Electrical Engineering Department, Pennsylvania State College, State College, Pa.
Woodcock, V. E., 123 S. Broad St., Philadelphia 9, Pa.

Admission to Member

Anderson, A. T., 541 Elm Ave., Inglewood 1, Calif.
Ashley, D. S., 3411 Martha Custis Dr., Alexandria, Va.
Bailey, D. L., 620 W. Ferry St., Buffalo 22, N. Y.
Baxter, E. G., Box 84, RCAF Station, Trenton, Ont., Canada
Becker, H., 1140 Crenshaw Blvd., Los Angeles 19, Calif.
Bell, D. E., 341 North 'J' St., Oxnard, Calif.
Bradbury, J. T., c/o Hastings Instrument Co., Inc., Superhighway & Pine Ave., Hampton, Va.
Carr, J. W., III, 1121 Bydding Rd., Ann Arbor, Mich.
Clements, D. F., Electrical Engineering Department, University of Delaware, Newark, Del.
Cobbs, D. M., R.F.D. 5, 7430 Julian, Denver 11, Colo.
Crusinberry, W. O., 214 Vado St., San Antonio, Tex.
Edwards, R. A., 41 King, Belleville, N. J.

(Continued on page 104A)

A PRECISION ANALOG COMPUTER

Typical Computer Installation

- A new chassis design—each chassis formed in a U-shape effecting an unusually compact arrangement of components and providing the facilities for extremely efficient cooling.
- A new high gain, low drift, contact stabilized d-c amplifier with outstanding accuracy, frequency response and output power characteristics.
- A new system (optional) for selecting and setting an attenuator to a value within approximately ± .005% by depressing the keys of an adding machine type keyboard.
- Compatibility with other makes of analog computing equipment which allows the precision components of this system to be used with other manufacturers' systems.
- A new high quality patch board assembly, using an 1000 position pre-patch panel made of metal to avoid leakages between terminals and to improve overall computer accuracy.
- All computing resistors and capacitors contained in an oven to maintain them at a constant temperature to insure reliable and accurate performance.
- Centralized operation of the entire computer from a control console providing maximum ease of operation and flexibility in the use of the system plus minimizing the cost of expansion.

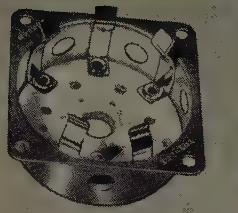
ELECTRONIC ASSOCIATES *Incorporated*

Long Branch, New Jersey

Send for complete data

PERFORMANCE PROVED...

JOHNSON SPECIAL SOCKETS


122-101-14

122-217-8

122-211-14

Engineered for longer life
Designed for top performance

JOHNSON electrical components include a complete line of special sockets for virtually every electronic application. Engineering skill, the result of years of specialized experience, and the most modern manufacturing facilities assure you of stock or custom-fabricated sockets that are both durable and dependable.

The special sockets shown here, variations of JOHNSON standard types, were designed to meet the punishing requirements of the 100 hour salt spray test. Construction successfully resists salt water corrosion, moisture condensation, and fungus growth; all contacts and contact springs are heavily silver plated to insure low loss and a positive electrical connection. Terminals are hot tin dipped, bases are of grade L-4 Steatite insulation with glazed top and sides. To provide added protection, all other surfaces are DC-200 impregnated.

122-101-14—Designed for Septar base tubes such as the 826, 829, 832, etc., this special socket has an anodized aluminum shell and provision for mounting mica button capacitors directly to the socket base. Five nickel plated, phosphor bronze retaining springs hold tubes securely in place and permit trouble-free operation in any position. A recessed base, solidly mounted on fungus resistant, phenolic washers, positively eliminates any contact movement.

122-217-8 thru 122-228-8—A series of ceramic wafer sockets designed to accommodate standard receiving tubes. Locating grooves speed tube insertion . . . beryllium copper retaining springs hold tubes firmly in place. Recessed phosphor bronze contacts prevent movement; countersunk rivets and boss located mounting holes permit sub-panel mounting.

122-211-14—A bayonet type socket for all tubes equipped with "50 watt" bases. Double beryllium copper filament contacts (.0005" silver plated), and hot tin dipped integral solder terminals insure positive contact with a minimum loss. Brass shell is .0003" nickel plated—ceramic base extends beyond contacts, increasing breakdown voltage rating.

JOHNSON special sockets, made to order in production quantities, meet all JAN material specification requirements. The complete JOHNSON standard socket line is listed in catalog 973, available on request.

Inquires are invited, and wherever possible we will gladly quote on "specials" to meet military requirements.

E. F. JOHNSON COMPANY
CAPACITORS, INDUCTORS, SOCKETS, INSULATORS, PLUGS, JACKS, DIALS, AND PILOT LIGHTS
204 SECOND AVENUE SOUTHWEST • WASECA, MINNESOTA

MEMBERSHIP

(Continued from page 102A)

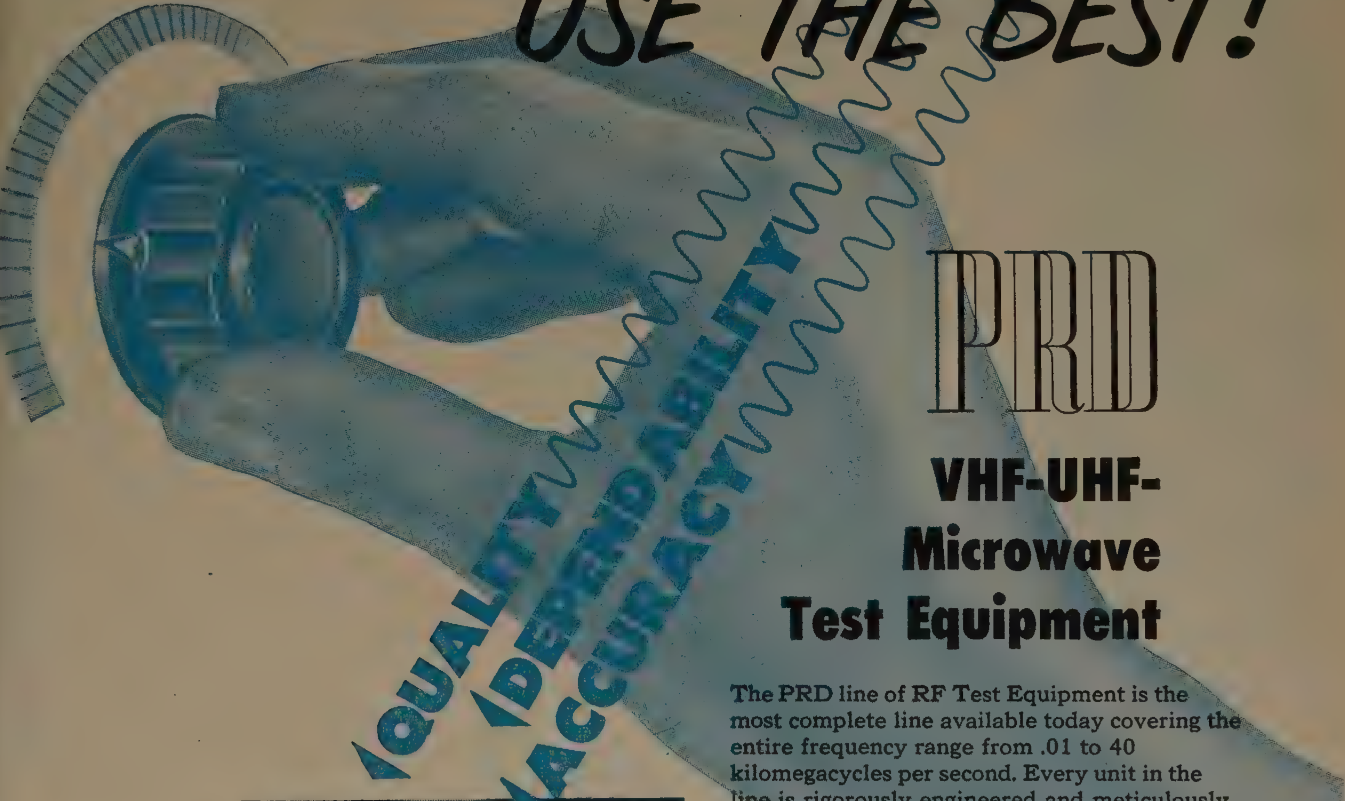
Farmer, W. B., 20 Rankin Ave., Basking Rid N. J.
Fells, W. E., Bendix Radio, McClellan Air Fo Base, Calif.
Flaherty, J. B., Jr., 3780 First St., S.E., Washingt 20, D. C.
Frank, K. F., Micro Balancing, Inc., 191 Herric Rd., Garden City Park, L. I., N. Y.
Guilfoyle, R. J., Box 456, Pompton Plains, N. J.
Hannigan, W. T., 43 Leon St., Boston 15, Mass.
Harries, W., Box 75, Hazlet, N. J.
Hesser, C. B., 145 Laurelwood Ct., Emporiu Pa.
Hink, K. G., R.F.D. 1, Dodge City, Kans.
Holt, W. J., Jr., 312 Edgefield St., Garland, Tex
Hubbell, B., Furnace Rd., Chester, N. J.
Hurvitz, H., 1023 Warner Bldg., Washingto D. C.
Jones, F. S., c/o Platte Pipe Line Co., 106 West St., Kansas City 5, Mo.
Jurafsky, A. J., 30 Ehrbar Ave., Mt. Vernon, N.
Kidd, A. T., 509—23 St., Santa Monica, Calif.
Kreitzburg, H. L., Jr., 11 Delano Pl., Dayton 1 Ohio
Lindsay, R. L., Apt. 12E, Sunnyside, K. U., Lawrence, Kans.
Meranda, J. I., 114 Belknap St., San Antonio, Te
Meuche, C. H., 223 Oak Knoll Dr., Dayton 9, Oh
Mieville, L. C. V., 338 East 87 St., New York 2 N. Y.
Molz, K. F., 1302 E. Belvedere, Baltimore 12, M
Mott, O. B., Detection Systems Section, Development Engineering, Westinghouse Electr Corp., Friendship Airport, Baltimore, M
Mulherin, E. M., R.F.D. 1, Millcreek Rd., Chalfon Pa.
Murphy, E. G., 332 E. Cheltenham Ave., Philadelphia 20, Pa.
Nicholls, J., 30, Hilderic Crescent, Holly Hal Dudley, Worcs., England
Peck, W. C., Allen St., Hazardville, Conn.
Pfeffer, P., 1011 Avenue 'C', Bayonne, N. J.
Pharo, E. W., Jr., 638 E. Rosalie St., Philadelph 20, Pa.
Price, H. W., Jr., Box 153, College Park, Md.
Pufahl, E. R., 2405 N. Melrose Ave., Melrose Par Ill.
Rittenhouse, J. W., 106 West Highway 72, Roll Mo.
Rosenberry, W. J., 1108 Belford Ave., Oklahom City, Okla.
Rowland, E. T., 713 Poplar Dr., Falls Church, V
Rummer, D. I., 203 E.E.L., University of Kansa Lawrence, Kans.
Schaaf, R. H., 533 N. Grove St., Oak Park, Ill.
Sharp, R. F., 238 S. Warner St., Woodbury, N. J
Smith, A. L., 4539 North 16 St., Phoenix, Ariz.
Stewart, W. E., 32 Bradford Dr., Winston Mano South San Francisco, Calif.
Stiles, J. E., 2136 Dewes St., Glenview, Ill.
Stinson, I. F., Headquarters, Ninth Air Forc Pope Air Force Base, Fort Bragg, N. C.
Stubbs, D. L., 313 Reynolds Rd., Barnwell, S.
Swafford, T. W., Jr., 1401 English St., Irving, Te
Takenaka, G., 850 West 18 St., Upland, Calif.
Tate, H. J., 163 S. Broadway, Lindenhurst, L. N. Y.
Unterberger, R. R., California Research Corp., Bo 446, La Habra, Calif.
Woodard, W. W., 5102 Crosswood Rd., Baltimo 14, Md.
Webner, R. D., 1524 Northland Ave., Lakewood Ohio
Youtcheff, J. S., 2207 Montana Ave., Santa Monic Calif.

The following elections to Associate grad were approved to be effective as of April 1953:

Adler, C., 160 West 174 St., New York, N. Y.

(Continued on page 106A)

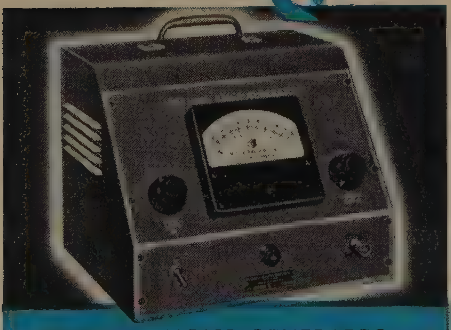
When you test—
USE THE BEST!



PRD

VHF-UHF-
Microwave
Test Equipment

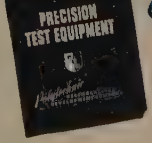
The PRD line of RF Test Equipment is the most complete line available today covering the entire frequency range from .01 to 40 kilomegacycles per second. Every unit in the line is rigorously engineered and meticulously manufactured to the highest standards attainable. The excellence of PRD equipment, in quality, dependability and accuracy is well attested by use in the leading laboratories throughout the world. For consultation on the application of standard or special PRD equipment to your problems call or write our skilled staff of engineers today, without obligation.



TYPE 904 NOISE GENERATOR — a direct reading instrument which permits measurements of noise factors up to 20 db for r-f amplifiers and receivers operating in the range from 10 to 1000 mc/s. A [illegible] noise diode with a nominal input impedance of 50 ohms is used. VSWR is approximately 1.25; housed in handsome steel cabinet.

THE NEW EXPANDED PRD LINE OF RF TEST EQUIPMENT INCLUDES — Frequency Measuring Devices, Signal Sources and Receivers, Attenuators and Terminations, Transmission Line Components, Impedance Measurement and Transformation Units, Bolometers, Detection and Power Measurement Equipment.

✓ WRITE TODAY
FOR YOUR COPY
OF THE NEW
PRD CATALOG —
NO OBLIGATION



Polytechnic RESEARCH
& DEVELOPMENT COMPANY · Inc

PRD

55 JOHNSON STREET, BROOKLYN 1, NEW YORK
WESTERN SALES OFFICE: 741½ N. SEWARD ST.
HOLLYWOOD 38, CALIFORNIA

we don't shrink heads...
but we do shrink
Transformers!

If you think Jivaro Indians were experts at shrinking things . . . (human heads, that is) . . . look what STANCOR engineers have done with transistor transformers! Recently they designed and are now producing the smallest transformer ever built!

How big is this new transformer? Well, it's just ¼" x ⅜" x ⅜" and it weighs only 0.07 ounce. Designed especially for transistor applications, this unit is no larger than the transistor it powers.

It is one of a series of transistor transformers, being built by Stancor, for development and commercial applications. If you are planning to use transistors, take advantage of Stancor's knowledge of engineering and manufacturing of ultra-miniature transformers.

STANCOR TRANSISTOR TRANSFORMERS

These stock transistor transformers are available through your Stancor distributor:

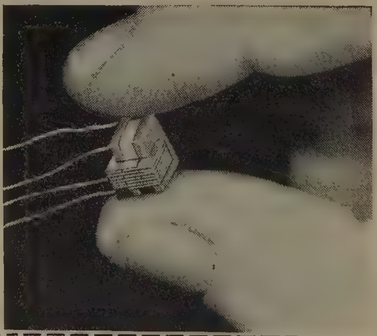
TYPE	APPLICATION	PRI. IMP.	SEC. IMP.
UM-110	Interstage	20,000	1,000
UM-111	Output or matching	1,000	60
UM-112	High imp. mic. to emitter	200,000	1,000

Other transistor transformers, built to your special requirements, are available for original equipment production only. Write for Bulletin 462.

STANCOR TINYTRANS
Miniature, cased audio transformers

Here are four new cataloged high fidelity transformers for use where space is at a premium. These units have a frequency response of ±1 db, 30–20,000 cps. They are impregnated and sealed in a ⅞" square, drawn aluminum can, with ⅛" terminals mounted on a phenolic terminal board. Total height is 1¼".

TYPE	APPLICATION	PRI. IMP.	SEC. IMP.
TT-11	Mic., pickup or line to single grid.	50, 200/250, 500/600	50,000
TT-12	Mic., pickup or line to push-pull grids.	50, 200/250, 500/600	50,000
TT-13	Dynamic mic., to single grid.	7.5/30	50,000
TT-14	Single plate to single grid.	15,000	60,000



Ask your Stancor Distributor for Bulletin 463 on Stancor Tinytrans, or write us for your free copy.

STANCOR

STANDARD TRANSFORMER CORPORATION
3582 ELSTON AVENUE • CHICAGO 18, ILLINOIS
EXPORT SALES: Roburn Agencies, Inc., 39 Warren Street, New York 7, N. Y.

MEMBERSHIP

(Continued from page 104A)

Alderson, W. S., 551 Foxhall Pl., S.E., Washington 20, D. C.
Anderson, R. S., 2036 N. Albany Ave., Chicago 47, Ill.
Arbogast, J. L., 5518 Grand Lake, Bellaire, Tex.
Arford, F. W., 911 Herald, West Covina, Calif.
Armstrong, R. H., 418 Lenox Ave., Fort Wayne 4, Ind.
Auday, W. S., Barberry Manor, Churchville Rd., Southampton, Pa.
Ausfresser, H. D., Westinghouse Electric Corp., Elmira, N. Y.
Bachofer, H. L., Sun Physical Laboratory, Bishop Hollow Rd., Newtown Square, Pa.
Baecklund, J. N., 102-A Maple Rd., State College, Pa.
Baker, W. R., Box 839, Milwaukee 1, Wis.
Ballard, F., 6 Flint Pl., Elmont, L. I., N. Y.
Barschel, E., 154 Kenny St., Norwood, Man., Canada
Barter, L. D., Box 49A, R.F.D. 1, Lake Zurich, Ill.
Bartzoff, J. S., 26 St. Paul St., Brookline 46, Mass.
Bates, A. E., Brookside Dr., Feasterville, Pa.
Bean, H. L., 810 S. Hawthorne Rd., Winston-Salem, N. C.
Beck, C. A., Charles Beck Machine Corp., 414 North 13 St., Philadelphia, Pa.
Bergeroth, L. C., Grand Rapids National Bank Bldg., Grand Rapids, Mich.
Berkeley, E. C., 36 West 11 St., New York 11, N. Y.
Berndt, M. M., 109 Tenth St., N.E., Cedar Rapids, Iowa
Beswick, J. D., Philco Technical Division, 22 St. & Lehigh Ave., Philadelphia, Pa.
Birchfield, W. P., 105-B Chase St., St. Andrews Homes, Charleston 32, S. C.
Blum, M. S., 5 Cypress Ave., Elberon, N. J.
Branum, M., 123 Manufacturing St., Dallas, Tex.
Brede, E. F., 18900 Warrington Dr., Detroit 21, Mich.
Britton, C. W., 229 East 109 St., Los Angeles 61, Calif.
Browning, C. R., Box 6043, Raleigh, N. C.
Buchanan, T. B., Box 701, 532 Oakwood Ave., Sanford, N. C.
Burkhart, R. N., 1788 Hackett Ave., Mountain View, Calif.
Burns, C. L., 750 East 'D' Ave., Glendale, Ariz.
Burtnyk, N., 340 Arlington Ave., Ottawa, Ont., Canada
Burundarena, C. A., Salta 1147, 3 P., Dto. P., Buenos Aires, Argentina
Butenbach, R. W., 174 Summit Ave., Summit, N. J.
Butterfoss, E. J., 559-A E. Tabor Rd., Philadelphia, Pa.
Calvert, C. C., 378—28 St., San Francisco 14, Calif.
Chaffee, C. W., 537 Day, San Francisco, Calif.
Chambers, G. R., Hughes Aircraft, Technical Representative, Tyndall AFB, Fla.
Chaplin, N. J., 51 Beatty Ave., Ajax, Ont., Canada
Chernikoff, L., 160 Wentworth Ave., Cincinnati 20, Ohio
Chodl, C., Jr., 1322 Wellington Ave., Chicago, Ill.
Clark, D. B., 303 A Langely, NOTS, Inyokern, China Lake, Calif.
Clawson, G. T., Box 113, Westernville, N. Y.
Cole, A. E., Jr., 2909 Shirey Ave., Baltimore 14, Md.
Coleman, J., Johnson & Hoffman Manufacturing Co., 55 Ongley St., Rockville Center, L. I., N. Y.
Colussi, E. J., 220 E. Benezet St., Philadelphia 18, Pa.
Crawford, R. L., 25 East 53 St., Tulsa, Okla.
Crossland, E. J., Seismograph Service Corp., Box 1590, Tulsa, Okla.
Dankworth, J. F., 207 E. Weber Rd., Columbus 2, Ohio

(Continued on page 109A)

MEMBERSHIP

(Continued from page 106A)

Davidson, R., c/o Dynamic Electronics, 73-39 Woodhaven Blvd., Forest Hills, L. I., N. Y.
Davis, T. R., 3864 Florence Dr., Alexandria, Va.
Dickey, C. W., 126 E. Hamilton Ave., State College, Pa.
Dickinson, H., 9533 Hildreth Ave., South Gate, Calif.
Dole, J., 615 S. Bluff, Wichita 17, Kans.
Draper, C. S., Massachusetts Institute of Technology, 77 Massachusetts Ave., Cambridge, Mass.
Dunn, C. E., 3704 Wilcox, San Diego 6, Calif.
Dutcher, L. R., 1565 Darby Ave., Pomona, Calif.
Echols, R. A., 2006 E. Portland St., Phoenix, Ariz.
Ekeroot, S. F., Lovelace Foundation, Albuquerque, N. Mex.
Engvik, S. B., Strentor Radio Factory, Trondheim, Norway
Epperson, R. D., Radio Station WPAQ, Mt. Airy, N. C.
Feingold, W., 50-08 Weeks La., Fresh Meadows, L. I., N. Y.
Filzen, J. N., Box 3320, R.F.D. 1, Lake Charles, La.
Fitchett, R. N., Jr., P.O. Haselton Branch, Rome, N. Y.
Forman, I., 47 Clinton St., New York 2, N. Y.
Friedman, M. I., 18 Pont St., Great Neck, L. I., N. Y.
Fuchs, A., Box 1, Kiryat Motzkin, Haifa, Israel
Gallagher, W. J., 1056 Embarcadero Rd., Palo Alto, Calif.
Gallant, M. B., 743 Miller Ave., Brooklyn 7, N. Y.
Gancher, L., 468 West Broadway, New York 12, N. Y.
Garcia, J. R., 29 Lenox Ave., White Plains, N. Y.
Giffin, G. S., 4304 S. E. Anthony Wayne Dr., Fort Wayne, Ind.
Gilliand, H. W., 3300 Chauncey Pl., Mt. Rainier, Md.
Gipple, H. W., 1084 Shafer Dr., Rafael Village, Navato, Calif.
Goodman, H., Cosmos Industries, Inc., 31-28 Queens Blvd., Long Island City, L. I., N. Y.
Graham, A. S., Box 77-C, R.F.D. 4, Huntsville, Ala.
Gran, R. W., 5422—56 Ave., East Riverdale, Md.
Greenberg, H., 510 Second Ave., Asbury Park, N. J.
Greene, B., 5 Elmire St., S.E., Washington 20, D. C.
Gretes, W. P., 401 Wayne Cir., Norfolk 13, Va.
Grieser, T. F., 5221 Greene St., Philadelphia, Pa.
Grossenbacher, A. C., 3555 N.E. 113, Portland 20, Ore.
Halloran, R. G., 16927 Livorno Dr., Pacific Palisades, Calif.
Hamilton, V. P., 5100 N. Winthrop Ave., Chicago 40, Ill.
Henchcliffe, A. L., 31 Miller La., Riverside, Conn.
Harms, F. G., 148 Webster Ave., Jersey City, N. J.
Hartenstein, W. G., 414 Hillsboro St., Raleigh, N. C.
Hausten, D. R., 1915 'E' Ave., N.W., Cedar Rapids, Iowa
Hepburn, J. C., 25 Cambridge St., Malverne, L. I., N. Y.
Herr, C. E., R.F.D. 1, West Middlesex, Pa.
Houghton, R. B., 2905 Taylor Ave., Baltimore 14, Md.
Huffman, D. L., 79 Clinton Heights Ave., Columbus 2, Ohio
Hussey, C. V., Jr., 1545 East 49 St., Tulsa, Okla.
Insinger, R. H., Jr., Church Rd., Hatfield, Pa.
Irish, F. E., Jr., 9 Lee St., Cambridge 9, Mass.
Isley, C. T., Jr., 241 Ridge Ave., Towson 4, Md.
Iwaniwsky, A. A., 360 East 72 St., Apt. 2, New York, N. Y.

(Continued on page 110A)

FM/AM SIGNAL GENERATOR TF 995

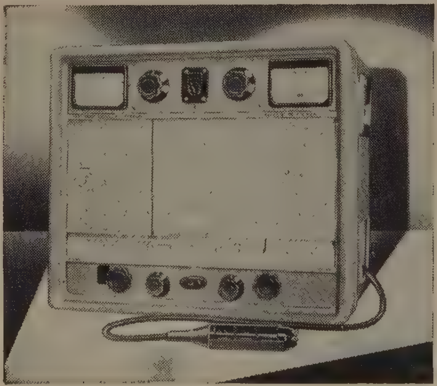
A crystal standardized generator either frequency or amplitude modulated. Frequency range: 13.5 to 216 megacycles. Output range 0.1 microvolts to 100 millivolts. Internal or external modulation gives f.m. deviations to 600 kilocycles and a.m. depths to 50 per cent.

UNIVERSAL BRIDGE TF 868

Measures inductance and capacitance at 1,000 cycles, resistance at d.c.; direct reading 1 microhenry to 100 henries, 1 micro-microfarad to 100 microfarads, and 0.1 ohms to 10 megohms. Q range 0.1 to 1.000, tanδ 0.001 to 10.

FM DEVIATION METER TF 934

With crystal-standardized deviation ranges of 5, 25 and 75 kilocycles, alternative high- and low-level buffered inlets, visual checking for optimum tuning and level, together with a separately buffered audio outlet, this ruggedized deviation meter is ideal for carriers in the range 2.5 to 200 megacycles.



STANDARD SIGNAL GENERATOR TF 867

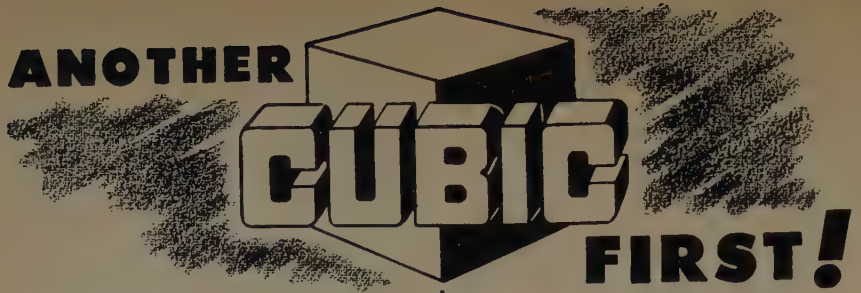
For precision receiver measurements: Covers on an expanded full-vision scale 15 kilocycles (or less) to 30 megacycles, crystal standardized, with an output continuously variable from 4 volts to 0.4 microvolts. Up to 100 per cent. a.m., with unmeasurable f.m., monitored by dual rectification.

MARCONI INSTRUMENTS

VACUUM TUBE VOLTMETERS • FREQUENCY STANDARDS • OUTPUT METERS
WAVE METERS • WAVE ANALYSERS • Q METERS • BEAT FREQUENCY OSCILLATORS

23-25 BEAVER STREET • NEW YORK 4

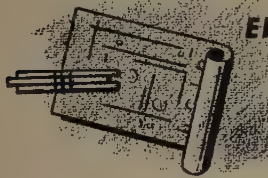
CANADA: CANADIAN MARCONI CO., MARCONI BUILDING, 2442 TRENTON AVENUE, MONTREAL
ENGLAND: Head Office: MARCONI INSTRUMENTS LIMITED, ST. ALBANS, HERTFORDSHIRE
Managing Agents in Export:
MARCONI'S WIRELESS TELEGRAPH COMPANY LIMITED, MARCONI HOUSE, STRAND, LONDON, W.C.2



To Satisfy . . .

. . . THE ELECTRONIC INDUSTRY'S DEMANDS . . .
. . . FOR NEW EQUIPMENT AND INSTRUMENTS . . .
. . . THAT PERFORM NEW TASKS . . .
. . . OR DO A MORE-PRECISE JOB . . .
. . . IS A NEVER-ENDING CHALLENGE . . .

To Cubic Electronic Experts

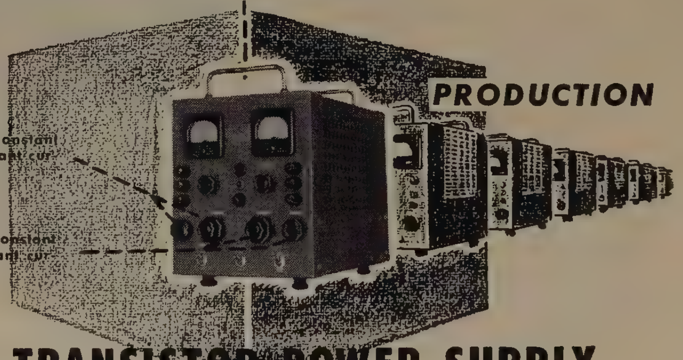


ENGINEERING

DESIGN and DEVELOPMENT

That Challenge Is Answered Again!

PRODUCTION



DC Supply "A" constant voltage or constant current control.

DC Supply "B" constant voltage or constant current control.

CUBIC MODEL 702 **TRANSISTOR POWER SUPPLY**

SPECIFICATIONS

Constant Voltage Output: (CVO) 0 to 20 V-DC @ 100 ma. max.
20 to 200 V-DC @ 100 ma. max.
Constant Current Output: (CCO) 0 to 50 ma. DC @ 100 V max.
Ripple: Less than 5 mv RMS over entire range
Regulation: Less than 0.1% var. zero to full load CVO
Less than 0.5% var. short circuit to 100 V CCO
Output Impedance: Less than 5 ohms from 20 cps to 50 mc
Supply Interaction: None
Dimensions: 8''x12''x11'' high

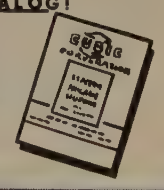
It's the day-by-day efforts of CUBIC'S skilled Electronic engineers and craftsmen—men who keep pace with the requirements of the Field—that make possible the addition of such outstanding equipment as CUBIC'S New TRANSISTOR POWER SUPPLY, to the proud CUBIC Catalog of equipment that once formed *Yesterday's* "First-In-The-Field". But research never rests.

To-day—at CUBIC—new ideas are being conceived and incubated into equipment to satisfy *To-morrow's* demands. In a few weeks, we will be pleased to release news of another CUBIC success . . . The Transistor Test Panel—a CUBIC *First for To-morrow*! Watch for it!

Perhaps you have a problem in development or production. CUBIC welcomes inquiries to help you solve these—or any problem in Electronics and Transmission.

NEW CATALOG!

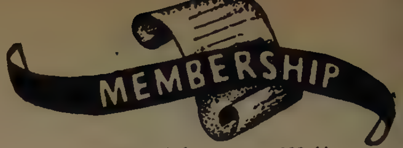
For absolute R.F. Power Measurement—with no guessing—from 100 MC to 26,000 MC—three Calorimetric Wattmeters are available. Send for the New Catalog of Microwave Components and Test Equipment.



CUBIC CORPORATION

Scott & Canon Streets
San Diego 6
California

Devoted Exclusively to Electronics & Electronic Equipment



(Continued from page 109A)

Jackson, J. C., 2159 Arroyo Dr., Pomona, Calif.
Jacoby, G. R., 238 N. Edgevale Rd., Columbus 9
Ohio
Jameson, W. B., 2815 Abbott Pl., N.W., Canton 8
Ohio
Jennings, A. L., 4520 Georgia Ave., N.W., Washington, D. C.
Joseph, W. F., 1914 Arroyo Ave., San Carlos, Calif.
Kariambas, N., 10 Sozopoleos St., Athens 8, Greece
Kelsey, L. C., 1955 Bradley Pl., Chicago 13, Ill.
Kohl, H. F., 1005 Spruce St., Schenectady, N. Y.
Koivu, H. I., 3130 Day Ave., Miami 33, Fla.
Kowalczyk, A. C., 1829 Osterlitz Ave., Schenectady, N. Y.
Kube, H. D., 1339 Wisconsin Ave., N.W., Washington 7, D. C.
Levitt, M., 91 Invermay Ave., Toronto, Ont., Canada
Lewis, P. M., II, 463 Beacon St., Boston, Mass.
Linblad, T. N., 554 Purcell Ave., Cincinnati 14, Ohio
Lindsay, J. E., 40 Lippincott, Long Branch, N. J.
Liss, F. T., 4520—36 St., N.W., Washington 8, D. C.
Liu, C. K., 303 Mather Blvd., Mather AFB, Calif.
Livesay, R., Sun Physical Laboratory, Bishop Hollow Rd., Newton Square, Pa.
Losew, W. S., 1638 S. Orkney St., Philadelphia 38, Pa.
Lott, R. E., Jr., 39 Rhoda Ave., Nutley 10, N. J.
MacKenzie, W. G., 15725 Cherrylawn, Detroit 21, Mich.
Mann, C. W., 424 W. Penn St., Carlisle, Pa.
Marek, M. B., 32 Chestnut, Holyoke, Mass.
Martin, K. L., 1810 Ingleside Ter., N.W., Washington, D. C.
Maser, B., 2451 N. Hollywood St., Philadelphia 32, Pa.
Masters, G. W., 2520 Third St., Cuyahoga Falls, Ohio
Mathews, V. M., Jr., 3044 South Eighth St., Kansas City, Kans.
Mattiat, O. E., 3275 Hyde Park Ave., Cleveland Heights 18, Ohio
Matto, V. G., 507—26 St., Union City, N. J.
McCarty, F. H., 13 Manor Rd., Broomall, Pa.
McCotter, J. L., Jr., 1904 New Bern Ave., Raleigh, N. C.
McDowell, W. J., 1061 Yule La., Ottawa 2, Ont., Canada
Medoff, J. L., 508 W. Mt. Airy Ave., Philadelphia 19, Pa.
Meiers, R. J., 121 Brighton Ave., Deal, N. J.
Melniker, B., 839 N. Martel Ave., Los Angeles 46, Calif.
Merrigan, A. F., 2917 Haverford Rd., Ardmore, Pa.
Meyer, E. F., 218 Pollydale Dr., San Antonio, Tex.
Michos, D. N., 205 Nicholson St., East Brunswick, Melbourne, Vic., Australia
Milkie, R. W., 110 W. South St., Angola, Ind.
Montgomery, A., c/o Link Aviation Engineering Department, Binghamton, N. Y.
Morphonios, A. G., 3131 N.W. 16 St., Miami, Fla.
Morris, K. G., 35-A Brookwood Garden Apts., Burlington, N. C.
Neau, O. R., 1121 Liku, Lanikai, Oahu, Hawaii
Oberlies, J. L., 22 Sleepy La., Hicksville, L. I., N. Y.
Okabe, T., 113, 3-Chomo Kugayama, Suginamiku, Tokyo, Japan
O'Neill, J. F., 68 Drexelbrook Dr., Drexel Hill, Pa.
Oom, D. G., 2320 Stevens Rd., Raleigh, N. C.
Opiela, A. D., Jr., 109½ East 18 St., Austin 1, Tex.
Ortiz, E., 502 West 180 St., New York 33, N. Y.
Oster, W., 1739 Standard Ave., Whiting, Ind.
Osterndorf, J. F., 9203—218 St., Queens Village 8, L. I., N. Y.
Overton, J. W., 201 Plainview Ave., Raleigh, N. C.
Palmer, H., 6128 Main St., Vancouver, B. C., Canada

(Continued on page 112A)

BOURNS
presents
the New
TRIMPOT
Trade Mark

***An adjustable . . .
Sub-miniature potentiometer
for precise circuit trimming***

BOURNS TRIMPOT is a wire-wound potentiometer designed for miniaturized equipment. Adjustments are simple and accurate . . . they are made by turning the exposed slotted shaft with a screw driver. Settings are securely maintained during severe shock, acceleration and vibration.

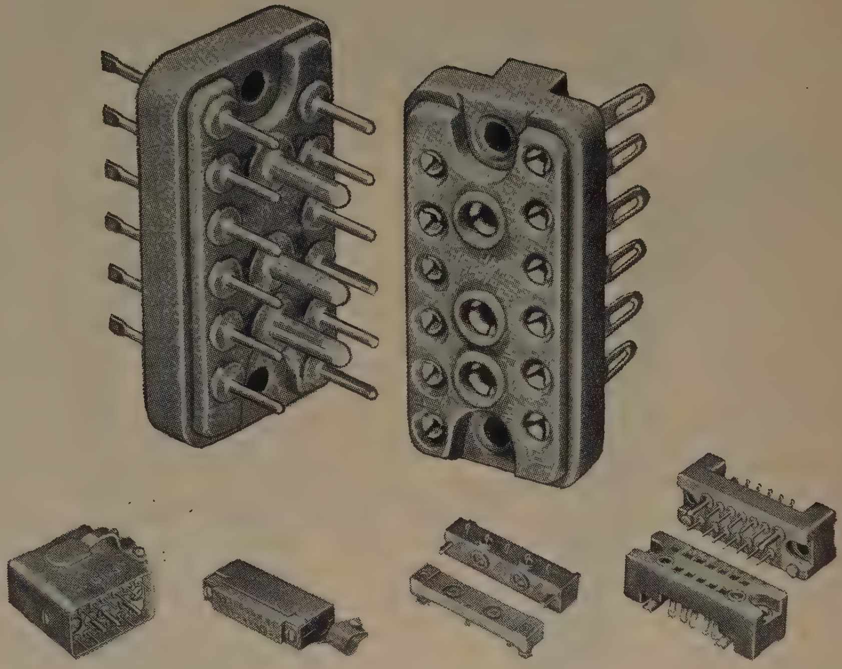
TRIMPOTs can be installed individually or in stacked assemblies with two mounting screws through the eyelets in the body. Superior electrical characteristics are achieved by the use of precious metal contacts and precision resistors.

BOURNS designs and manufactures other potentiometers which measure linear motion, gage pressure, differential pressure, altitude and acceleration.

BOURNS
LABORATORIES
6135 Magnolia Avenue, Riverside, California
Technical Bulletin on request, Dept. 72

HHB
Rack & panel connectors . .

Meet requirements for
SIZE . . TYPE . . CAPACITY!



HHB is proud of its many assignments during past years to design and manufacture hundreds of types and sizes of rack and panel connectors for specific applications in electronics.

We invite you to become acquainted with HHB skill and craftsmanship! Ask for the new catalog that has many illustrations of HHB products.

CONNECTORS—CABLE ASSEMBLIES & COMPONENTS
for America's electronics industry . . .

**H. H. BUGGIE
And Company**
TOLEDO 4, OHIO
Sales Engineers in All Principal Cities

Skilled in Electronic Component Parts
RESEARCH · DESIGN
ENGINEERING
MANUFACTURING

For the first time

FLEXIBLE WAVEGUIDE with power rating equal to that of rigid guide!

BANK ON Airtron inc. for

HIGH POWERED FLEXAGUIDE® for RADAR applications

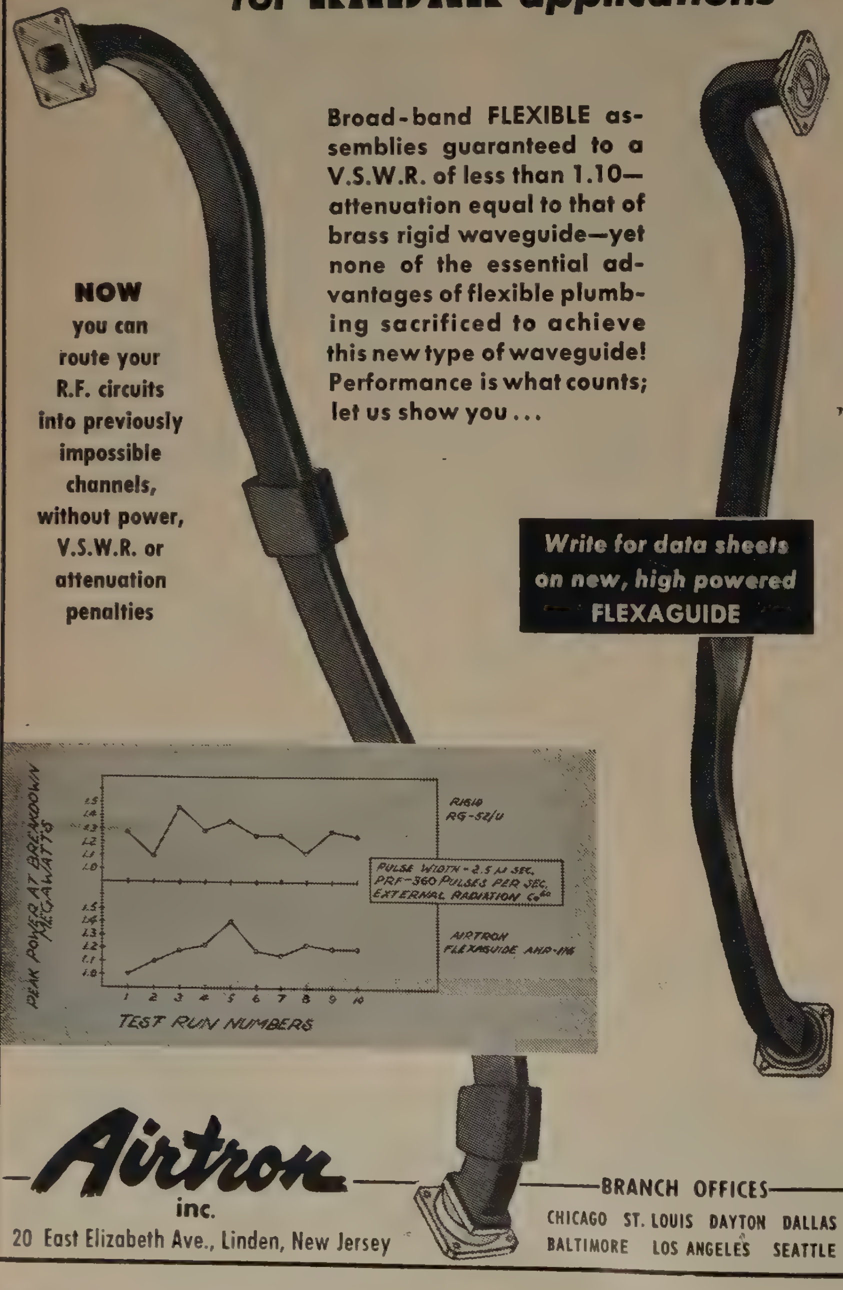
Broad-band FLEXIBLE assemblies guaranteed to a V.S.W.R. of less than 1.10—attenuation equal to that of brass rigid waveguide—yet none of the essential advantages of flexible plumbing sacrificed to achieve this new type of waveguide! Performance is what counts; let us show you . . .

NOW you can route your R.F. circuits into previously impossible channels, without power, V.S.W.R. or attenuation penalties

Write for data sheets on new, high powered FLEXAGUIDE

Airtron inc.
20 East Elizabeth Ave., Linden, New Jersey

BRANCH OFFICES
CHICAGO ST. LOUIS DAYTON DALLAS
BALTIMORE LOS ANGELES SEATTLE



MEMBERSHIP

(Continued from page 110A)

Paul, J. S., 111 Plainview Ave., Raleigh, N. C.
Paxton, T. N., 1411 Mentor, Dallas 16, Tex.
Peth, R., 6856 N. Olcott Ave., Chicago 31, Ill.
Petrik, J. S., 123 Hinsdale Rd., Syracuse 8, N. Y.
Phillips, W. S., 1107 Fulton Rd., N.W., Canton 3, Ohio
Picard, H. E., 650 River Rd., Fair Haven, N. J.
Pirart, M. A., East Wellington P.O., Nanaimo, B.C., Canada
Platt, B. E., 7175 Montague St., Philadelphia 35, Pa.
Posthill, B. N., Robin Hill, Media, Pa.
Poulos, B. J., 140 Meridian Rd., Levittown, L. I., N. Y.
Prast, J. W., General Delivery, Converse, Tex.
Prather, W. E., 173 E. Roselawn, San Antonio, Tex.
Rembert, R. P., 3d AACS I & M Squadron, APO 862, c/o Postmaster, New York, N. Y.
Richardson, R. M., Broad Rin Dr., Sterling, Va.
Ritter, L., 1040 Eastern Pkwy., Brooklyn 13, N. Y.
Rossi, C. E., 1825 Pr. Bulnes, Buenos Aires, Argentina
Rothstein, R. I., 414 Hillsboro St., Raleigh, N. C.
Rowley, R. J., 1248 Fifth Ave., S.E., Cedar Rapids, Iowa
Rudd, R. B., 312 B Princeton Rd., Haddonfield, N. J.
Russell, J. F., Jr., 900 Norris St., Raleigh, N. C.
Russell, W. D., 108 Atlantic Ave., Long Branch, N. J.
Samuel, J., 3728 Hayes St., N.E., Washington 19, D. C.
Sathe, M. D., Chief of Wireless, Western Railway, Bombay Central, Bombay 8, India
Saylor, R. A., 1452 Jackson St., San Francisco, Calif.
Schlenger, S. B., 610 East 20 St., New York 9, N. Y.
Scott, R. W., 4129 Rosalie, Houston 4, Tex.
Sessler, J. G., 22 Village Colony, Fort Wayne, Ind.
Shea, J. W., 847 Fingerboard Rd., Staten Island, N. Y.
Sheffs, J. F., 1143 John Marshall Dr., Falls Church, Va.
Siegel, I. D., 5854 De Giverville, St. Louis 12, Mo.
Sigler, A., 984 Glenmore Ave., Brooklyn 8, N. Y.
Smith, C. E., Box 43, R.F.D. 2, Joplin, Mo.
Smith, E. M., 67 W. Charlotte St., Millersville, Pa.
Snyder, S. S., 1202 Hamilton St., N. W., Washington 11, D. C.
Sorden, L. V., 518 S. East St., Oxnard, Calif.
Speaker, B., R.F.D. 2, Walnut St., Neptune, N. J.
Spease, G. E., 636 N. Hanover, Carlisle, Pa.
Spongberg, R. C., 58 Cushing St., Medford 55, Mass.
Stanger, L., 251 D Garfield Ave., Collingswood 7, N. J.
Steinberg, M. I., 16 Fairview Ave., Tuckahoe, N. Y.
Stender, L., 136 Ordrupvej, Chattottenlund City, Denmark
Steoger, J. E., 28 Lincoln Ave., Mt. Ephraim, N. J.
Sterner, E. L., 1143—28 St., Marion, Iowa
Stewart, E. A., 1769 Curtis Ave., Manhattan Beach, Calif.
Taplin, L. B., 1761 Webb, Apt. 101, Detroit 6, Mich.
Thoresen, J. C., 333 Gorton Lake Blvd., Greenwood, Warwick, R. I.
Tidd, E. D., Box 14, Clinton, N. J.
Townsend, G. B., 811 Berchman St., Plainfield, N. J.
Triplett, W. R., 107 E. Kibler St., Bluffton, Ohio
Uncapher, K. W., 1122 B Euclid St., Santa Monica, Calif.
Van Buskirk, R. C., 452 Park Overlook Dr., Worthington, Ohio
Wack, C. B., 1164 Hickory St., Grafton, Ohio
Wade, D. A. L., British Embassy, Washington, D. C.

(Continued on page 114A)

Top Service

IS ASSURED WHEN YOU ORDER YOUR

RAYTHEON TUBES

and JUNCTION TYPE

TRANSISTORS

FROM

DALIS

Metropolitan New York's Foremost Electronic Distributor

Immediate Delivery From Stock

Seal of HLD Service

PHONE: ALgonquin 5-3000
WRITE or WIRE: Dept. IND
TELETYPE: N. Y. 1-2482

H. L. DALIS INC.

WHOLESALE DISTRIBUTORS
ELECTRONIC EQUIPMENT
175 VARICK ST., NEW YORK 14

SERVING THE TRADE FOR OVER A QUARTER CENTURY

NEW!

RG/ LOW TEMPERATURE CABLE

for SIGNAL CORPS and AIR FORCE

- *Full Electrical and Mechanical Efficiency at –40° C.*
- *Non-Contaminating Black Jacket.*
- *Identification by Ink Marking to Eliminate Thin Spots on the Jacket.*

For several years the Signal Corps has been looking for a cable jacket compound that meets the requirements listed above. In addition, the cable must be capable of being bent around a mandrel ten times the diameter of the cable at –40° C. without cracking. AMPHENOL's new low temperature cable, now on a production basis, not only fully meets all of these requirements but also provides a large safety margin.

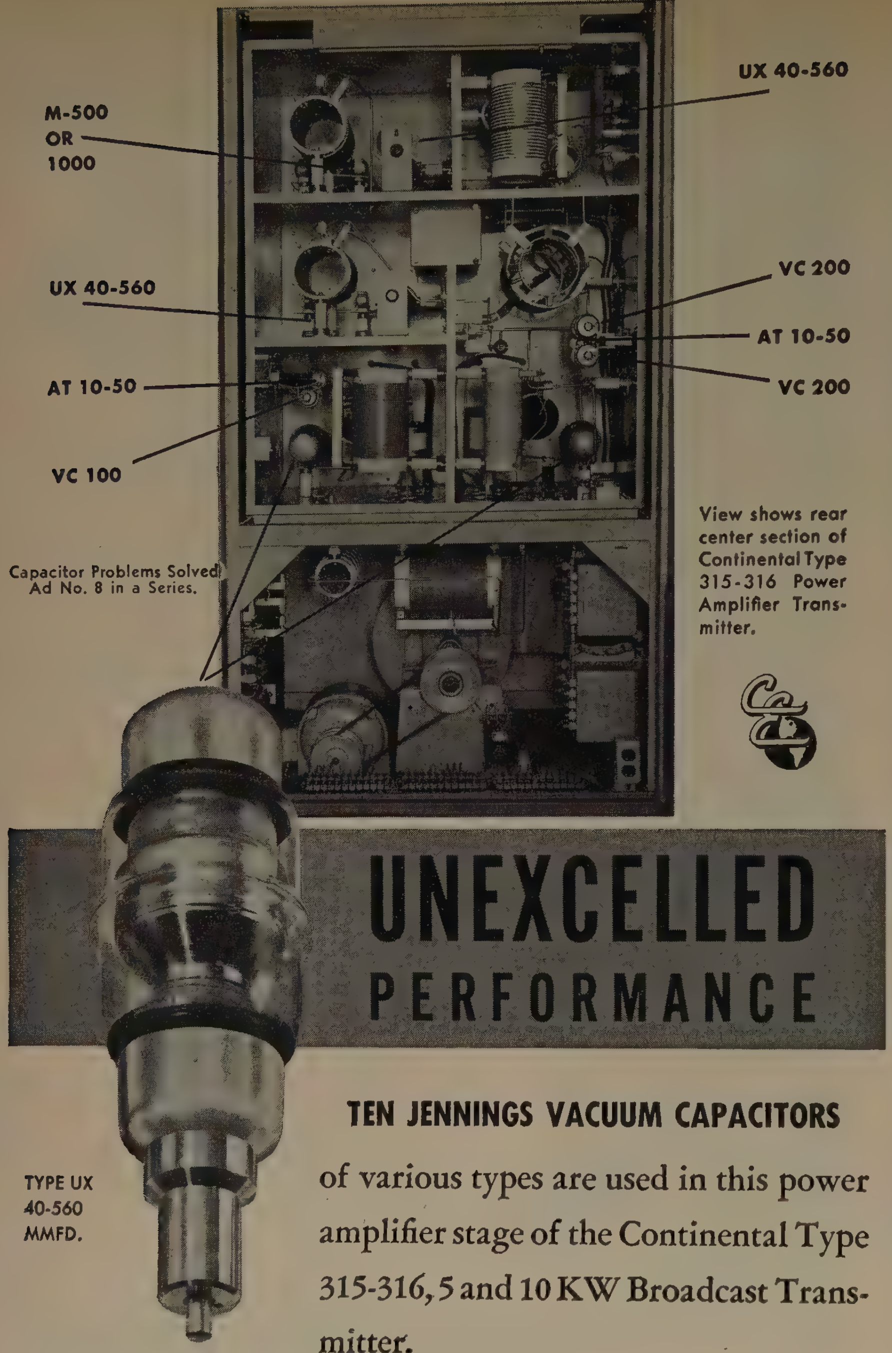
CONNECTORS for RG/ CABLES

Because AMPHENOL has complete laboratory and engineering facilities, research on RF Connectors is a constant development. New connectors are constantly being added to the list of cataloged items. As a result, AMPHENOL offers the most complete selection of quality RF Connectors available from a single manufacturer.

For complete information on the entire line of AMPHENOL manufacture, write today for your free copy of the AMPHENOL B-2 General Catalog.

AMERICAN PHENOLIC CORPORATION
1830 SOUTH 54TH AVENUE • CHICAGO 50, ILLINOIS

AMPHENOL


UX 40-560
M-500
OR
1000
VC 200
UX 40-560
AT 10-50
AT 10-50
VC 200
VC 100
View shows rear center section of Continental Type 315-316 Power Amplifier Transmitter.
Capacitor Problems Solved!
Ad No. 8 in a Series.
TYPE UX
40-560
MMFD.

UNEXCELLED PERFORMANCE

TEN JENNINGS VACUUM CAPACITORS

of various types are used in this power amplifier stage of the Continental Type 315-316, 5 and 10 KW Broadcast Transmitter.

Your circuits may be simplified and improved by using fixed or variable Jennings Vacuum Capacitors.

We invite your inquiries regarding specific applications.

Use Jennings Vacuum Capacitors for applications involving: Automatic tuning over wide frequency ranges • Permanent and trouble-free service • High ratio of capacitance change • Dust, moisture, and high altitude • High voltages and currents • Small physical size • Resistance to shock • Accuracy of reset • High frequency • Low loss

Jennings RADIO
VACUUM ELECTRONIC COMPONENTS

LITERATURE MAILED ON REQUEST

JENNINGS RADIO MANUFACTURING CORPORATION • 970 McLAUGHLIN AVE.
P.O. BOX 1278 • SAN JOSE 8, CALIFORNIA

MEMBERSHIP

(Continued from page 112A)

Wagner, H. B., 824 E. Cypress Ave., Burbank, Calif.
Wallace, W. C., 702 Virginia St., Raleigh, N. C.
Warner, D. E., 2106 Ellis, Wichita 9, Kans.
Waskiewicz, L. R., 289 Glenwood Ave., East Orange, N. J.
Watson, J. F., Louisburg, Mo.
Weinstein, G., 3504 Rochambeau Ave., New York 67, N. Y.
Weir, A. G., 3010 W. Cullom, Chicago 18, Ill.
Weisman, I., 2811 Exterior St., New York 63, N. Y.
Wille, R. A., Johnson & Hoffman Manufacturing Co., 65 Ongley St., Rockville Center, L. I., N. Y.
Willyard, C. H., 837 Marengo Ave., Forest Park, Ill.
Wolf, L., 307 West 92 St., New York 25, N. Y.
Wolfe, B. F., 781 AC & W Sqdn., Ft. Custer, Battle Creek, Mich.
Wolff, E. R., 339 Vaughan St., Winnipeg, Man., Canada
Wyatt, K. S., Parkside Way, Irvington, N. Y.
Yeiser, J. O., 1441 Elm St., El Cerrito, Calif.
Young, G. W., 676 S. Everett, Columbus 13, Ohio
Zaks, Z. W., Kiryat Chayim, 2—13 St., Haifa, Israel
Zeliff, R. J., 47 Wayne Pl., Nutley 10, N. J.
Zick, B. A., 5 Clifton Ave., Newark 4, N. J.
Zolin, F. H., 2443 N. Cramer St., Milwaukee, Wis.

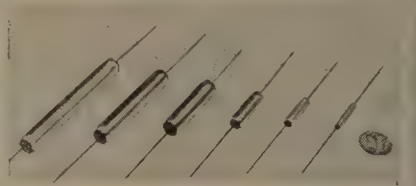
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 63A)

Tantalum Foil Electrolytic Capacitors

Cornell-Dubilier, Elec. Corp., Industrial Div., South Plainfield, N. J., has succeeded in producing a new and improved capacitor which combines the advantages of both the aluminum electrolytic type, and that of the tantalum.



The new C-D Type TAN tantalum electrolytic capacitor is much more compact than its predecessor, has no corrosive electrolyte, and is more rugged.

It will operate at +85° and exhibit a very low leakage current at this temperature. Since it has a wound foil type construction, it has a good frequency characteristic.

The TAN electrolytic capacitor is available in a variety of capacity and voltage ratings from any Cornell-Dubilier distributor. It is available in both polarized and non-polarized types, with voltages up to 150 W. V. Bulletin No. 523 on tantalum electrolytics is available from the firm.

(Continued on page 116A)

LOOKING FOR A

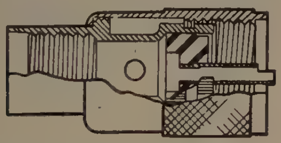
Perfect Mate?

COAXIAL CONNECTOR CO. offers a fresh, economical and improved approach to the manufacture of the "Old Reliables." Practical know-how stands solidly behind every connector made by Coaxial.

It has been proved time and again that our J.A.N. precision-made connectors have been held aloft as a standard for the industry. Pride of workmanship coupled with a short manufacturing cycle insures the kind of product that you want when you want it.

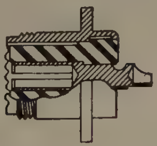
Design problems? Engineering information? Special requirements? Engineering specialists will give you the benefit of Coaxial's know-how.

UHF SERIES CONNECTORS
For dependable low-cost, general purpose use. Satisfactory up to 200 megacycles and may be used with caution up to 500 megacycles.



AN Designation
PL-259, PLUG (NT. 49190)
Non-weatherproof type. Mates with UHF female. Two-piece construction. For use with Cable RG-/U: 8, 9, 10, 11, 12, 13, 63, 65.

AN Designation
PL-259A, PLUG (NT. 49195)
Similar to PL-259. It is a 3-piece unit for ease of handling. Non-weatherproof. Mates with UHF female. SO239.



AN Designation
SO-239, NT. 49194 Receptacle
Mates with male plugs PL-259, PL-259A, UG-203/U. Non-weatherproof, single piece construction. For use with Cable RG-/U8, 9, 10, 11, 12, 13, 63, 65.

Also available special Adapter for the above Plugs (UG-175/U, UG-176/U) used with RG-58/U, RG-59/U, RG-62/U and other small cables.

FREE! *Cross Reference Chart! Just ask for it or for more information.*

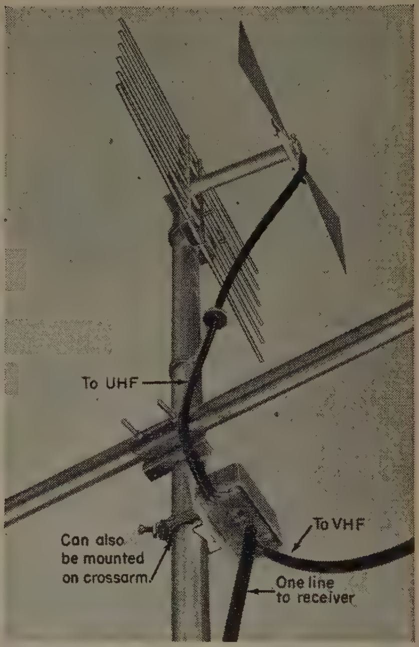
COAXIAL CONNECTOR CO.
35 N. 2nd Ave., Mt. Vernon, N. Y. MOunt Vernon 8-6416
CBWU—GOVERNMENT DESIGNATION

EBY CROSSOVER NETWORK

combines UHF and VHF

Into a Single Antenna System

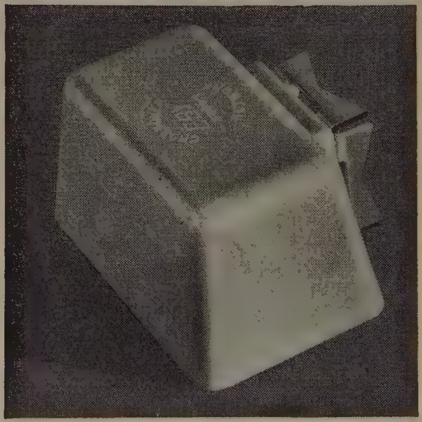
The EBY CROSSOVER NETWORK is a device designed for insertion between the UHF and VHF antennas in such a manner as to minimize interference and signal losses. The insertion loss of this device over both the 54 to 216 MC, VHF range, and the 470 to 890 MC, UHF range, is approximately 1 db which is much less than losses obtained using dual transmission lines and a UHF switching unit.



The* EBY CROSSOVER NETWORK *has been thoroughly field tested and gives superior performance.

The* EBY CROSSOVER NETWORK *is in production.

Samples and further information on request.



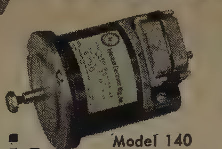
WRITE TODAY TO:

HUGH H. EBY INC.

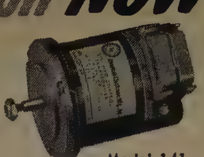
4702 Stenton Avenue • Philadelphia 44, Pa.

In large scale production **NOW!**

American Electronic



Model 140
SYNCHRO GENERATORS



Model 141
SYNCHRO CONTROL TRANSFORMERS

A pair with an established reputation.
The heart of modern two-speed systems.

IN MASS PRODUCTION THIS SPRING!

Size 15
UNIVERSAL-FREQUENCY PRECISION RESOLVER
Minimum noise, highest accuracy. Basic to all trigonometric operations.

Size 15
UNIVERSAL-FREQUENCY PRECISION POTENTIOMETER
Continuous rotation, induction type. Accuracy comparable to resolver.

Model 171
SERVO COMPUTING TACHOMETER
Companion to Model 172 Servomotor. Superior linearity and signal-to-noise ratio

READY FOR FALL DELIVERY:
Size 11 Induction Resolvers, and Potentiometers • Sizes 11 and 15 Servo Control Motors and Computing Tachometers • Model 293 Brushless Potentiometers.

Model 172
SERVO CONTROL MOTORS
"Standard" in many modern computers and controls. Thousands in use

FEATURES

- Maximum accuracy, signal-to-noise ratio, range of linear operation.
- Minimum noise, size and friction.
- Total magnetic shielding.
- Internal winding or external network compensation.
- High temperature resistant models.
- Corrosion and fungus resistant.
- Complete line of "packaged" compensating isolation driver-amplifiers.
- Reliable delivery commitments.

American Electronic Mfg., Inc.
9503 W. Jefferson Blvd., Culver City, Calif.

New **800-2600** mcs **FREQUENCY METERS**

Lightweight — Portable Units

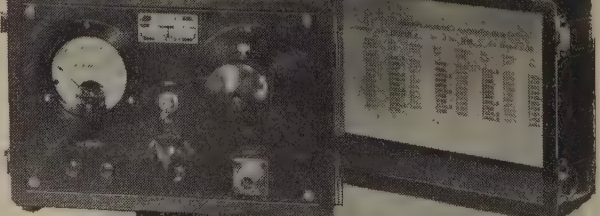
...For Field and Laboratory Use!

SPECIFICATIONS

1. **ACCURACY**
   Better than .05% from 20°F to 120°F
2. **SENSITIVITY**
   Usable indication with 1 milliwatt input
   Adjustable for higher levels
3. **INDICATOR**
   50 Microammeter
4. **INPUT**
   50 Ohm Type N Connector
5. **EXTERNAL DC OUTPUT**
   Pin Jacks
6. **EXCURSION OF MICROMETER**
   One-half inch
7. **MICROMETER SCALE**
   at 1000 Mc —
   1 Division equals 290 KC
   at 1400 Mc —
   1 Division equals 350 KC
   at 2000 Mc —
   1 Division equals 450 KC
   at 2600 Mc —
   1 Division equals 555 KC
8. **EXTERNAL SIZE**
   6½ x 9¾ x 7"
9. **WEIGHT**
   Four pounds

Models
FS-C-171-A 800-1200 MCS.
FS-C-172-A 1200-1600 MCS.
FS-C-173-A 1600-2250 MCS.
FS-C-174-A 1700-2600 MCS.

Units consist of cavity body, micrometer control, crystal, suitable connectors and calibration chart. Write for specifications and prices.



(Cavity units are also available for custom housing)

frequency standards
P. O. Box 504.
Asbury Park, New Jersey

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 114A)

Microwave Test Equipment

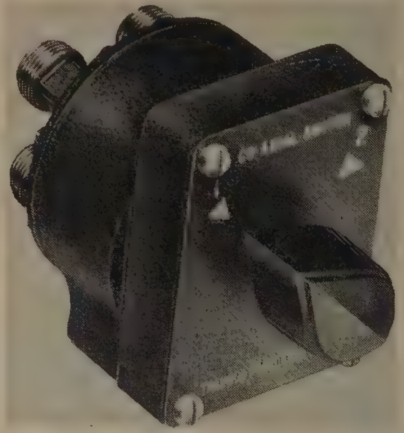
Cascade Research Corp., 53 Victory Lane, Los Gatos, Calif., announces a new development in microwave test equipment, the "UNILINE." This new device utilizes the ferromagnetic Faraday effect to achieve a non-reciprocal transmission line element. It is not a directional coupler. Operation is such that microwave power can be transmitted in one direction through the unit with less than 1 db attenuation, whereas power transmitted in the opposite direction will be very substantially attenuated.

The Uniline is intended for use in microwave test measurements, particularly those in which the impedance of the load is variable.

Present units cover the frequency ranges from 8,800 to 9,600 mc and 9,600 to 10,400 mc, (one range per unit) and are intended for use with $\frac{1}{2} \times 1$ inch waveguide. Physical dimensions are 6½ inches in length with standard UG39/U flanges on both ends. Maximum average power level is 5 watts in the high attenuated direction. No wires or external connections of any sort are required.

A descriptive bulletin covering theoretical and practical aspects is available from the manufacturer. Price is $115.00.

Coaxial RF Switches



Transco Products, Inc., 12210 Nebraska Ave., Los Angeles 25, Calif., has developed three new manually operated switches. The first is an SP-4 position multi-circuit switch for monitoring 4 frequencies, selecting 4 video channels, communications, and radar work. The weight is 1.5 lbs. The second is a SP-DT flexible general purpose switch. It can

(Continued on page 118A)

need relays?

Potter &
Brumfield
is your
BEST SOURCE
for
CUSTOM-BUILT RELAYS

here's why!

Design

Fast, accurate development of relays for every electrical and electronic application to meet the most exacting military or industrial specifications.

Engineering

Extensive research, laboratory and model shop facilities available to help solve design engineers' most complex relay problems.

Manufacturing

Three large, fully equipped plants geared to meet today's rigid production requirements . . . single shift capacity of 10,000 relays per day!

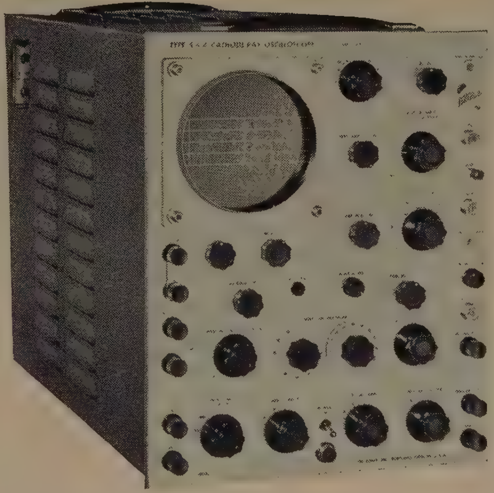
- Samples, Recommendations and Quotations on Request.
- P & B Sales Engineers in Principal U. S. and Canadian Cities.
- Write for Master Catalog Showing Full Line of Basic Structures.
- Standard Relays Available At Your Electronic Parts Distributor.

Potter & Brumfield
PRINCETON, INDIANA
Export: 13 E. 40th St., N. Y., N. Y.

Announcing

A greatly improved instrument to succeed the very popular Type 514-D Cathode-Ray Oscilloscope . . .

THE Type 514-AD



- **New Vertical Amplifier** 6 cm undistorted deflection
- **New Precision 5″ CRT** improved geometry and edge focus
- **New Direct-Coupled Unblanking**
- **New Variable Duty Cycle Calibrator**
- **New Sweep Amplifier**
- **New Improved Sweep Magnifier**

With its many important new characteristics the Type 514-AD comes even closer to providing everything you need in a general-purpose laboratory oscilloscope. Excellent transient response, 10 mc bandwidth, 6 cm undistorted vertical deflection, and wide time base range increase the depth of investigation possible with this versatile new instrument. High quality design and construction assure long, trouble-free service.

Condensed Specifications

Vertical Amplifier
Risetime—0.04 μsec
Bandwidth—dc to 10 mc
ac—2 cycles to 10 mc
Sensitivity—dc, 0.3 v/cm to 100 v/cm
ac, 0.03 v/cm to 100 v/cm
Signal Delay—0.25 μsec
Calibrator—0 to 50 v square wave, accurate within 3%, duty cycle variable 2% to 98%

Time Base Range
0.1 μsec/cm to 0.01 sec/cm, continuously variable, accurate within 5%
Single, triggered, or recurrent sweeps
5x sweep magnifier

3 kv Accelerating Potential, flat-faced crt
All dc voltages electronically regulated

Type 514-AD—$950 • Type 514-A (without delay network) $900

Prices f.o.b. Portland, Oregon

WRITE FOR COMPLETE SPECIFICATIONS

TEKTRONIX, Inc.
P. O. Box 831B, Portland 7, Oregon • Cable: TEKTRONIX

only TURBO

miniaturization wire
stands temperatures
from -55°c to
+105°c . . . . . AND MEETS OR
BEATS ALL OTHER
REQUIREMENTS OF
JAN-C-76 AND MIL-W-5086

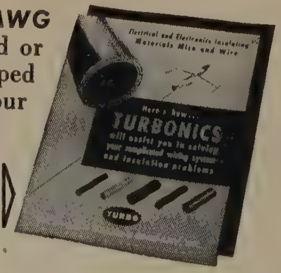
ACTUAL SIZE
of a 22 GAUGE (7/30)
VINYL INS. - 0.0075"
NYLON INS. - 0.0025"
MAX. O.D. - 0.0058"

PROVE TO YOURSELF that wire does not need bulky insulation to stand extreme temperatures, or give you insulating values above 1000 megohms per 1000 ft.

SEND FOR A SAMPLE of Turbo Miniaturization Wire. Test it on any electronic application where the continuous operating voltage does not exceed 600 volts R.M.S. See how its thin extruded vinyl primary insulation and thinner extruded nylon jacket resist boiling water, oils, fuels, hydraulic fluids, fungus, abrasion, etc.

TURBO MINIATURIZATION WIRE COMES IN AWG SIZES FROM 30 TO 12 GAUGE . . . in standard or flexible wiring . . . in solid colors, or candy-striped colors with 1, 2 or 3 tracer combinations, to fit your circuit coding needs.

BULLETIN A-4662 gives you more information about TURBO insulation. Ask for it when requesting your samples of TURBO Miniaturization Wire. Write Dept. P-5.


Electrical and Electronic Insulating Materials Wire and Wire
Here's how...
TURBONICS
will assist you in solving your complicated wiring system and insulation problems
TURBO

INSULATING MATERIAL TURBO THE BRAND ONLY BRAND MAKES
THE WILLIAM BRAND AND CO., INC.
North and Valley Streets, Willimantic, Connecticut — Phone 3-1661

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

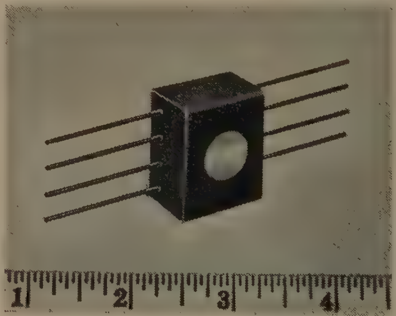
(Continued from page 116A)

connect 2 receivers of 2 transmitters to a common antenna, or select antennas for a common line. It will handle audio, video, communication, and radar frequencies. Weight is 1.4 lbs. The third is a DP transfer switch which can be used as SP-DT, or to interchange 2 circuits, or to insert a filter or attenuator in line. It offers extremely good cross-talk protection. Weight is 1.2 lbs. All of the Transco switches have the same rf head construction and give the same reliable performance as this company's remotely controlled coaxial rf switches. Panel or chassis mounted, compact and rugged, these switches are designed for use on frequencies up to 11,000 mc. Attenuation between connectors is 60 db minimum. The VSWR is under 1.3/1 to 11,000 mc. Characteristic impedance: 51.5±2 ohms. (Type 'N' fittings) Power rating: 100 watts CW at 3,000 mc. Voltage rating: 1000 volts RMS.

Ferro-Resonant Flip-Flop

The new ferro-resonant flip-flop (Model 133) recently announced by **Computer Research Corp.**, 3348 W. El Segundo Blvd., Hawthorne, Calif., features a smaller, more rugged package requiring only ⅛ cubic inch for mounting space. In addition the new package has reduced the cost by fifty per cent.

This item was developed as a vacuum tube replacement for certain counting, scaling and storage applications. It has the long life, low power requirements, and low heat dissipation of the saturable reactor, and is exceptionally compact, simple, and relatively inexpensive.



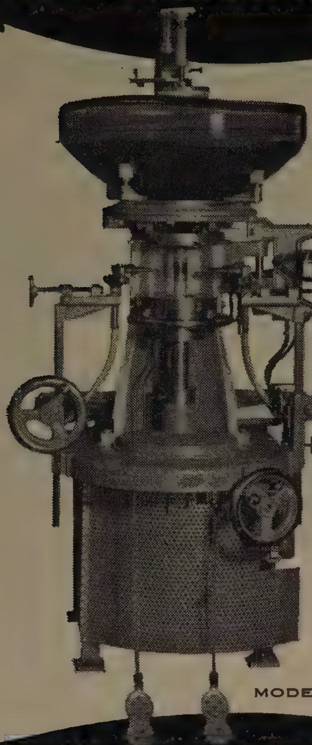
It will operate on a fraction of the power needed by a vacuum tube of comparable output, and can deliver more than 90 per cent of the input energy as usable output, since copper and core loss are the only source of power consumption. The use of non-dissipating reactive elements virtually eliminates the problem of heat dissipation. Since there's no filament, the new Model 133 will not wear or burn out.

Other features include operation at frequencies up to 100 kc, high power gain, immunity to high acceleration and shock, and the ability to withstand wide temperature, humidity, and pressure changes.

Literature explaining the new Model 133 in detail is available from Computer's Director of Applications.

(Continued on page 120A)

TV TUBE SALVAGE in ONE OPERATION



MODEL 2185

combination neck cutting and neck splicing machine

Salvage larger size (24" to 33" and up) cathode ray picture tubes with the new machine designed specifically for this purpose. Rejects can be easily, rapidly returned to the assembly line with this new versatile machine since all operations are performed handling the bulb once.

Features of Model 2185 include:

Single head . . . All standard TV tube sizes and shapes

NECK CUTTING
Cuts by the hot-chill method producing a clean, square cut. Cut-off mechanism adjustable up and down.

NECK SPLICING
Upper Centering Chuck automatically lines up the bulb. Lower Centering Chuck moves up and down.

GUN SEALING
Special gun mount pin is available for this purpose.

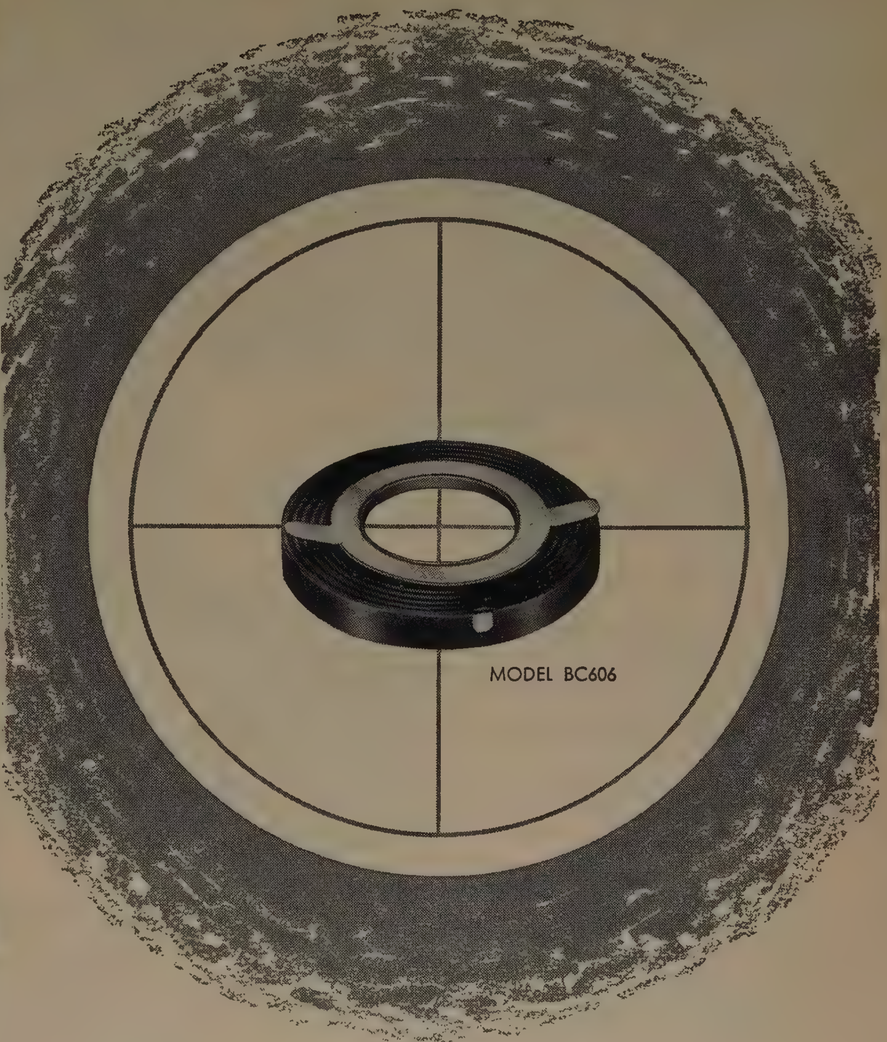
Model 2185 is but one of the many machines designed by Kahle through the past 40 years for the electronic industry. Where custom machinery will solve a production problem, call in Kahle or write now for help with specialized problems.

KAHLE — for "built-in know-how"

Kahle
ENGINEERING COMPANY
1310 SEVENTH STREET
NORTH BERGEN, N. J.

---

a HEPPNER original!



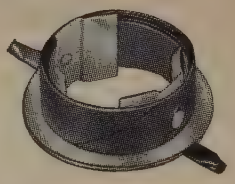
MODEL BC606

centering devices

For use with Electrostatic TV tubes of all sizes.

Distortion-free beam is assured by uniformity of field. Will not de-focus beam.

The two models differ only in mounting. Model BCC606 mounts easily on the deflection yoke. Model BCC603 mounts directly on the tube, adjacent to the deflection yoke and is held securely in place by phosphor bronze tension springs. Beam centering is done by rotating individual magnets.



MODEL BC603

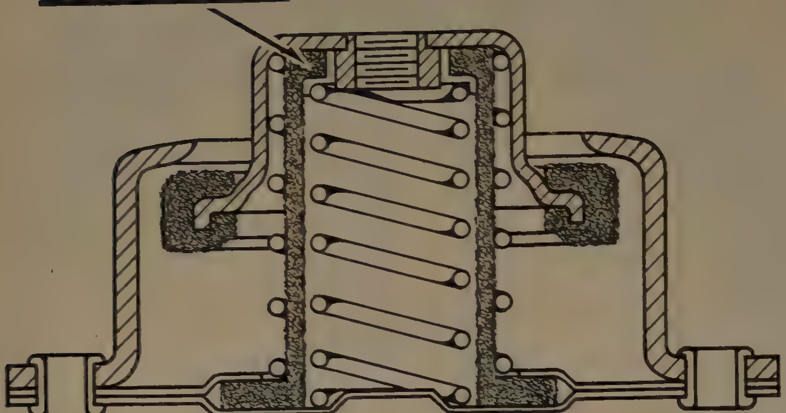
Each unit is tested in both open and closed position before shipment.

HEPPNER
MANUFACTURING COMPANY
Round Lake, Illinois (50 Miles Northwest of Chicago)
Phone: 6-2161
SPECIALISTS IN ELECTRO-MAGNETIC DEVICES

Representatives:
John J. Kopple
60 E. 42nd St., New York 17, N. Y.
James C. Muggleworth
506 Richey Ave., W. Collingswood, N. J.
Ralph Haffey
R. R. 1, U. S. 27, Coldwater Rd.,
Ft. Wayne 3, Indiana
Irv. M. Cochrane Co.
408 So. Alvarado St., Los Angeles, California

SHOCK AND VIBRATION NEWS

HERE'S THE SECRET



. . . of a NEW
wire-mesh isolator
that won't change
on the job!

The new Type 7630 and Type 7640 ALL-METL Barrymounts have been specifically designed to eliminate loss of efficiency due to damper packing. Previous wire-mesh unit vibration isolators exhibited a definite loss of damping efficiency after a period in actual service, because the wire-mesh damper tended to pack. These new unit Barrymounts have eliminated this difficulty, because load-bearing spring returns damper to normal position on every cycle.

- Very light weight — helps you reduce the weight of mounted equipment.
- Hex top — simplifies your installation problems.
- High isolation efficiency — meets latest government specifications (JAN-C-172A, etc.) — gives your equipment maximum protection.
- Ruggedized — to meet the shock-test requirements of military specifications.
- Operates over a wide range of temperatures — ideal for guided-missile or jet installations.

Compare these unit isolators with any others — by making your own tests, or on the basis of full details contained in Barry Product Bulletin 531. Your free copy will be mailed on request.

Free samples for your prototypes are available through your nearest Barry representative.

THE BARRY CORP.
716 PLEASANT ST., WATERTOWN 72, MASSACHUSETTS

SALES REPRESENTATIVES IN
Atlanta Baltimore Chicago Cleveland Dallas Dayton Detroit Los Angeles Minneapolis New York Philadelphia Phoenix Rochester St. Louis San Francisco Seattle Toronto Washington

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(*Continued from page 118A*)

Power Supply

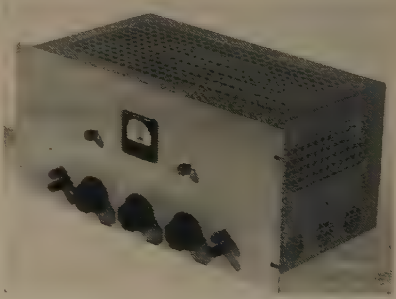
Kepco Laboratories, Inc., 131-38 Sanford Ave., Flushing 55, N. Y., has a new regulated low voltage, high current dc power supply (Model 3200) with excellent regulation, low ripple content, and low output impedance.

The low voltage supply is continuously variable from 1–13 volts, and delivers from 0–10 amperes continuous duty. In the range 0–13 volts the output voltage variation is less than 0.5 per cent for both line fluctuation from 105–125 volts and load variation from minimum to maximum current. The ripple voltage is less than 10 millivolts.

Cabinet height $22\frac{3}{4}$, width $21\frac{3}{4}$, depth $15\frac{1}{4}$ inches. Rack panel height is 21, width 19 inches, color gray, panel engraved.

Voltage Regulator

A new voltage regulator, the Kay-Lab Super-Regulator, has been designed by **Kalbfell Labs., Inc.**, P.O. Box 1578, 1090 Morena Blvd., San Diego 10, Calif., to provide low internal impedance, plus low noise with maximum flexibility and reliability.



It does not include the rectifier and main power transformer as it has been designed for use in conjunction with ordinary dc power supplies. It works equally well from either regulated or unregulated power supplies and if preceded by an unregulated supply, LC filtering is unnecessary if a large input capacitor is

(*Continued on page 122A*)

The Complete Answer to
TRANSFORMER TERMINAL PROBLEMS

E-I High Creepage Terminals

—WITH LONG LEAKAGE PATHS TO COUNTERACT HIGH MOISTURE AND CORROSION TROUBLES

E-I Terminals of this type provide maximum protection against leakage due to moisture or surface films. The glass bead is specially shaped to increase the leakage path yet the terminal requires no larger mounting area. Double protection is afforded by a silicone treating of the terminal. Rugged construction, plus carefully annealed glass permits rough handling in shop assembly thereby reducing rejects of assembled components. All E-I terminals are hot-tinned

E-I Rigid Multiple Headers

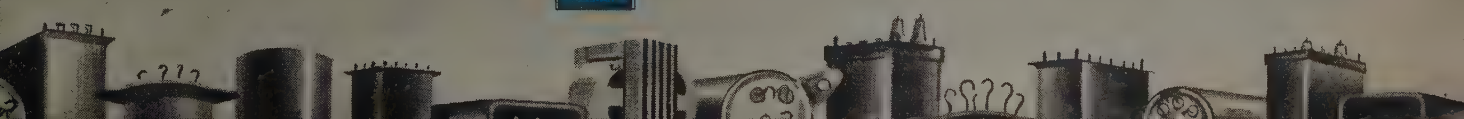
— FOR EVERY GROUPED TERMINATION REQUIREMENT INCLUDING PLUG-IN TYPES

E-I Rigid Headers feature an entirely new method of hermetic sealing developed by Electrical Industries. This method of construction which includes solid metal blanks in place of the usual thin metal stamping, yields a header that is far more rugged than any other type yet produced. The result is effective, permanent sealing under the most extraordinary conditions of shock and vibration.

E-I . . . YOUR HEADQUARTERS FOR HERMETICALLY-SEALED MULTIPLE HEADERS, OCTAL PLUG-INS, TERMINALS, COLOR CODED TERMINALS, END SEALS, etc. WRITE FOR CATALOGS.

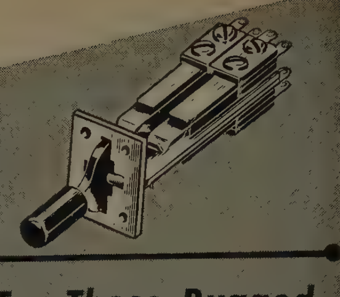
DIVISION OF AMPEREX ELECTRONIC CORP.

ELECTRICAL INDUSTRIES
44 SUMMER AVENUE, NEWARK 4, NEW JERSEY



SWITCHCRAFT*
NEW
TELEVER
SWITCH

For Those Rugged Applications



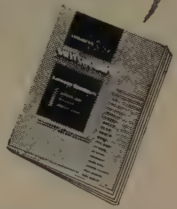
A unique design telephone type lever switch, rugged but light construction. For applications requiring dependable switching. Made in 2 and 3 position types, both locking and non-locking.

"LEV-R-SWITCH"
A smaller switch for single hole mounting. Available in many popular and less complex circuits.

MODIFICATIONS
Our flexible tools make modifications to meet special requirements economical and practical.

Write for catalog of standard switches and other components. For modifications please furnish complete information—applicable specifications, quantities, etc., for prompt handling of your inquiry.

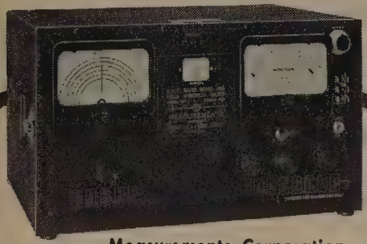
This NEW CATALOG Should Be In Your File!



SWITCHCRAFT INC.
1332 N. Halsted St., Chicago 22, Ill.
Canadian Representative: Atlas Radio Corp. Ltd., 560 King St. W., Toronto 2B, Canada. Phone: Waverly 4761

* The name "Switchcraft" is a registered trade mark and is the property of Switchcraft, Inc.

AVAILABLE AT ALL LEADING RADIO PARTS JOBBERS •



Measurements Corporation
MODEL 58

UHF RADIO NOISE & FIELD STRENGTH METER

Frequency Range
15 Mc. to 150 Mc.

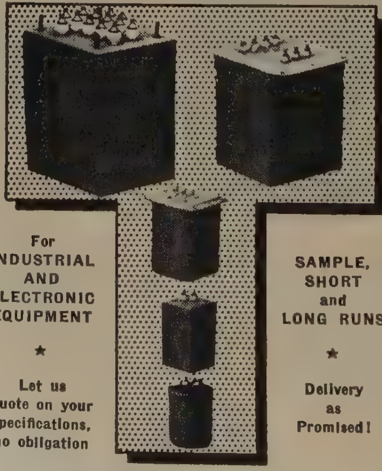
FREQUENCY ACCURACY: ±2%. Individually calibrated dial.

SENSITIVITY RANGE: 1 to 100,000 microvolts. Direct reading dial.

POWER SUPPLY: Built-in supply, 117 volts AC, 6 volts DC.

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY

EPCO
TRANSFORMERS
" Fill Your Need to a "



For INDUSTRIAL AND ELECTRONIC EQUIPMENT
★
Let us quote on your specifications, no obligation

SAMPLE, SHORT and LONG RUNS
★
Delivery as Promised!

DESIGNED TO COMMERCIAL AND MILITARY SPECIFICATIONS (MIL-T-27 and AN-E-19)

EPCO Products Inc.
2500 Atlantic Ave.
Brooklyn 7, New York

News—New Products

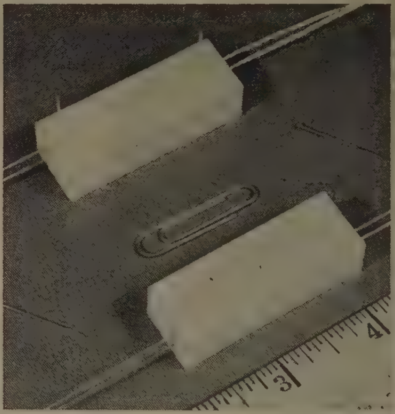
These manufacturers have invited PROCEEDINGS readers to write for literature and further technica information. Please mention your I.R.E. affiliation

(Continued from page 120A)

employed. The amplifier gain at mid frequencies is in excess of 105 db. Voltage range is 200 to 350 volts. Current range is 0 to 600 ma. DC regulation factor for 500 ma change is 0.003 per cent. Hum and noise at output is 50 microvolts or less. Transient output for 500 ma step function is 5 millivolts. Internal current drain is 50 ma. maximum. Internal impedance dc is 0.005 ohms. Output voltage for 10 per cent line voltage change is 0.1 per cent. Voltage stability is 0.1 per cent.

Subminiature Delay Line

The Jacobs Instrument Co., Bethesda 14, Md., has developed a compact potted delay line. This line is so designed that it can be mounted easily and firmly on a panel of any type. It is of lumped-constant design.



The time delay of the line is 2.5 microseconds (or 5 μsec if a reflection is used), and the attenuation is 2 db. A number of these lines can be used in series to give any integral multiple of the basic 2.5 μsec delay.

The line is very compact, having dimensions of 1 31/32×11/16×$\frac{1}{2}$ inch. It weighs 0.68 ounce. The characteristic impedance is 2,800 ohms. The line is completely sealed in a stable thermosetting resin.

A rise time of 0.5 μsec is combined with compact construction by the use of mutual inductance between elements.

Improved Amplifier

Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass., has a new model of the 210-B Dynaural labora-

(Continued on page 146A)

Consistent QUALITY...

Put ARC On the Map

On air map or road map of New Jersey, you will see the name "Aircraft Radio" marking our location just N.N.W. of Boonton.

Names don't appear on the map overnight. It takes stability and reputation. And as we approach our 25th anniversary, it is gratifying to know that A.R.C. has been "put on the map" in another sense, too. All over the world, A.R.C. is known and our communications and navigational instruments are widely used and trusted.

A.R.C. has become a standard of excellence in its field because it is quality-built for precision rather than price. Into each unit go the finest of components—plus 24 years of specialized engineering experience.

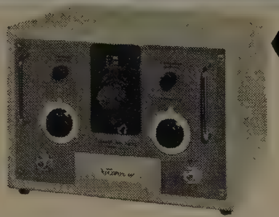
VHF NAVIGATIONAL RECEIVERS
MARKER BEACON RECEIVERS
ISOLATION AMPLIFIERS
LF RANGE RECEIVER WITH LOOP
VOR TEST EQUIPMENT
MICROWAVE TEST EQUIPMENT

ARC

Dependable
Electronic Equipment
Since 1928

Aircraft Radio Corporation
BOONTON NEW JERSEY

NOW VECTRON'S Microwave SPECTRUM ANALYZER Provides More Operating Frequencies You Need



NEW L-BAND R. F. HEAD

- Tuning range 900 to 2400 megacycles
- Dual attenuated input
- Stabilized coaxial tuning

VECTRON'S new 20L1 (L-band) R. F. Head is engineered for immediate operation, without conversion or adaptation, in the Vectron SA10 or SA20 Spectrum Analyzer Chassis. It provides spectrum analysis in the important microwave frequencies from 900 to 2400 megacycles which include a considerable region allocated to aeronautical radio, navigation, radar, TV remote pick-up, radiosonde and government services.

Specific Band Coverage . . . Vectron's Spectrum Analyzer SA20, with the 20L1 R. F. Head and other heads, such as S-band and X-band, provides a wide choice of operating frequencies in a single, compact unit . . . eliminates the unnecessary bulk and expense of equipment which covers large areas in unused bands.

Interchangeable R. F. Heads can be placed in immediate operation without conversion or adaptation of the Head or Analyzer. Individual Heads and SA20 Analyzers are available for early delivery.

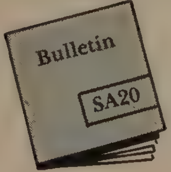
For Microwave Radar and Communications Equipment
The Vectron SA20 Spectrum Analyzer presents visually the frequency distribution spectrum of the power output of pulsed or CW microwave oscillators and can be used as a sensitive RF detector for checks and measurements in the design, production and maintenance of microwave radar and communications equipment and components.

FEATURES

Large, clear 5" oscilloscope pattern
Standard bezel to accept camera, hood or filter
Minimum number of controls . . . maximum operating convenience
Double conversion assures I. F. alignment stability
Built in regulated supply for Klystron oscillators
Easy access for maintenance or adjustment

SPECIFICATIONS

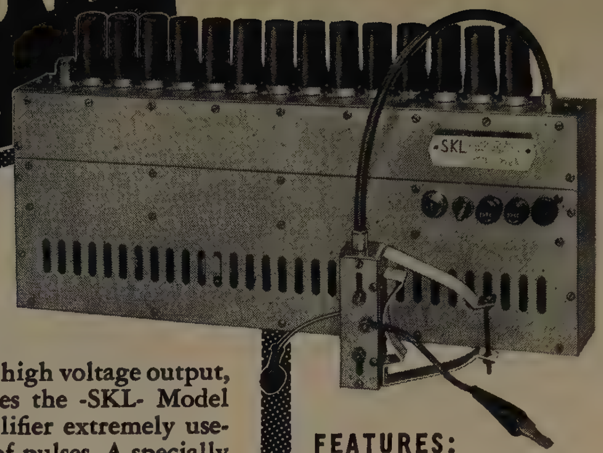
Overall Gain—130 decibels.
Sensitivity—Approx. −60dbm for 1 usec. pulse width.
IF Bandwidth—Choice of 50 kc, recommended for CW and 0.2 to 2 usec. pulse widths, or 20 kc. bandwidth to 5 usec.
Sweep Frequency—10 to 30 cps standard—available to 2 cps and with long persistence tube.
Power Requirements—105 to 125 volts. 60 cycles.



Vectron's development program includes additional R. F. Heads to cover microwave frequencies newly opened for military and civilian use. For information on these additional R. F. Heads and for complete engineering and operating data, send for Bulletin SA20. Write today and be sure to specify the operating frequencies you need.

VECTRON also offers custom design and production facilities for development and contract manufacture of servo-mechanisms, communication networks and filters, gyro-mechanisms, electronic systems, electro-mechanical equipment and instrumentation. Write us today and specify your requirements.

VECTRON, inc.
Electronic and Electro-Mechanical Equipment
402 MAIN STREET, WALTHAM 54, MASS.



IMPROVED
214B PULSE AMPLIFIER

200 CPS to
90 mc BANDWIDTH

Extended bandwidth, high voltage output, and fast rise time makes the -SKL- Model 214B Chain Pulse Amplifier extremely useful for detailed studies of pulses. A specially designed terminating cable provides direction connection to the deflection plates of a cathode ray tube. The flat frequency response and linear phase shift of the Model 214B Chain Pulse Amplifier are valuable in the testing and development of pulse circuits for radar, nuclear, and UHF research.

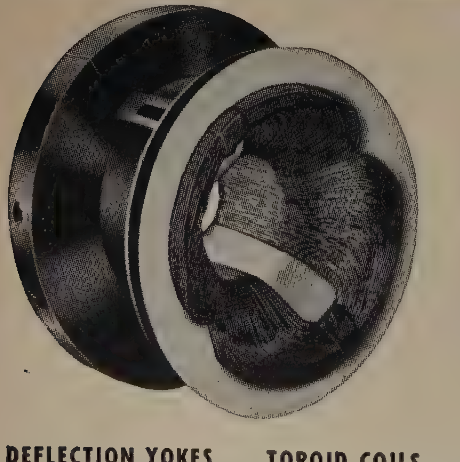
For further information write for Bulletin 214-2.

FEATURES:

- Rise Time: 0.006 μsec.
- Pulse Gain: 30 db
- Maximum Output Voltage: 125V
- Bandwidth: 200 cps — 90 mc
- Stabilized screen supply

SKL SPENCER-KENNEDY LABORATORIES, INC.
186 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.

DX Announces
a NEW 90° YOKE for 27" TUBES



It's Engineered for TOP PERFORMANCE ... in Production NOW!

This new DX 90° Deflection Yoke has everything a television receiver manufacturer wants . . . a sharp full-screen focus, a minimum of pincushioning, the ultimate in compactness and a price that's downright attractive. Because this yoke has been brilliantly designed for mass production on DX's specialized equipment, it warrants immediate consideration in your 27" receiver plans. Write us today.

DEFLECTION YOKES . . . TOROID COILS . . . CRYSTALS
I. F. TRANSFORMERS . . . R. F. COILS . . . DISCRIMINATORS
SPEAKERS . . . TV TUNERS . . . ION TRAPS . . . TRANSFORMERS

DX COMPONENTS "the heart of a good television receiver" TRADE MARK

DX RADIO PRODUCTS CO.
GENERAL OFFICES: 2300 W. ARMITAGE AVE., CHICAGO 47, ILL.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

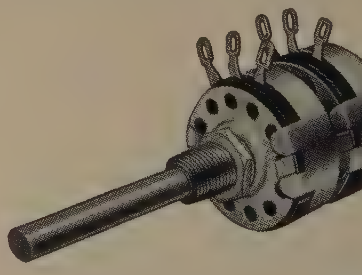
(Continued from page 122A)

tory amplifier. Called the Dynaural noise suppressor, it incorporates greatly increased effectiveness of "rumble" suppression where new loudspeaker systems with extended bass response are used. Since lower musical bass is reproduced with such speakers, the music system is also made more susceptible to annoying turntable or record rumble. Now, the new Dynaural circuits virtually eliminate rumble without losing any musical tones audible to the ear. In addition, the basic record-equalization circuits and the automatic loudness control (compensated volume control) have been redesigned to give superior results with new extended bass-response speakers. Wide-range compensation for virtually all record characteristics is accomplished by individual adjustment of the continuously variable 3-channel treble and bass controls, which modify the basic built-in equalization. An adjustable record-distortion filter is provided to limit high frequency response to what actually is recorded on the record. A self-balancing phase inverter automatically balances power output tubes. Descriptive booklet and bulletin on request.

Potentiometers Mounted In Tandem

Dual molded composition potentiometers, Type AB, consisting of two units mounted in tandem and controlled by the rotation of one shaft, are now being offered by **Ohmite Manufacturing Co.,** 4897 W. Fluornoy St., Chicago 44, Ill.

Type AB molded composition potentiometers are distributed by Ohmite exclusively through radio and television parts distributors. These 2-watt potentiometers are designed for industrial, laboratory, radio, television, and electronic service applications where reliability is particularly important. The resistance element, heat-treated under pressure, is a thick, solid-molded ring, and not a sprayed film or paint-type resistor. The new dual units have 2 inch long, round shaft, independent electrical connections.



These "noise-free" potentiometers are available in the linear curve type. Seven resistance values are available, ranging from 10,000 ohms to 1.0 megohm. For a complete description and dimensional drawings of these Dual Type AB potentiometers, write to Ohmite requesting Bulletin 131B.

(Continued on page 148A)

RAWSON METERS

Types:
501A 501C

Accuracy
½ of 1%

MULTI-METERS and REGULAR METERS

AC and DC types, high accuracy, multiple ranges, 2 microamperes to 1 ampere DC. 2 milliamperes to 3 amperes AC.

ELECTROSTATIC VOLTMETERS

Ranges 100-v to 35,000-v. AC or DC. Resistance exceeds million megohms. Can measure static electricity.

FLUXMETERS

Laboratory and production measurements on magnets and magnetic circuits. Single push button return-to-zero.

ROTATING COIL GAUSSMETER

Our most recent development for measuring magnetic field strengths. Measures from a few gausses to 120 kilogausses.

Special apparatus built to order—write for details and estimates

RAWSON ELECTRICAL INSTRUMENT CO.
118 Potter St. Cambridge, Mass.
Representatives
Chicago Los Angeles

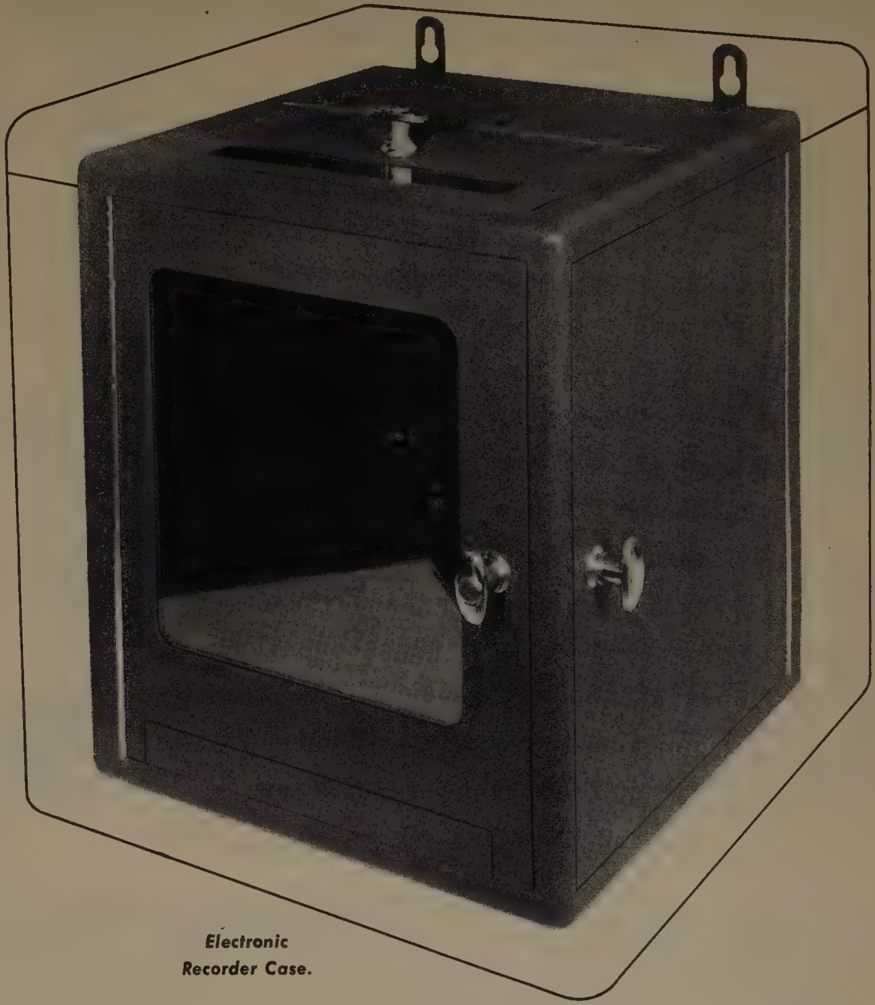
FIRST WITH THE FINEST IN . . .

- **CATHODE-RAY OSCILLOGRAPHY**
  Instrument Division,
  750 Bloomfield Ave., Clifton, N.J.
- **CATHODE-RAY TUBES AND COMPONENTS**
  Cathode-ray Tube Division,
  750 Bloomfield Ave., Clifton, N.J.
- **TELEVISION TRANSMITTING EQUIPMENT**
  Television Transmitter Division,
  1500 Main Ave., Clifton, N.J.

DU MONT

ALLEN B. DU MONT LABORATORIES, INC.

THERE'S QUALITY IN THIS CASE!



Electronic Recorder Case.

. . . from RIESTER & THESMACHER, of course!

Highest quality and finest craftsmanship—at reasonable cost—can be tailored to your sheet metal fabrication needs. Thousands of sheet metal products, each representing an individual problem, have received superior design, workmanship and service from Riester and Thesmacher. Write direct or contact your nearest representative. Your inquiry is welcome.

Aluminum Spot Welding
Heliarc Aluminum Welding

• REPRESENTED BY •

Frank W. Taylor Co.
P.O. Box 316, DeWitt, N. Y.

Paul R. Sturgeon
25 Huntington Ave., Boston 16

Kenneth E. Hughes Co.
17 W. 60th St., New York 23

Samuel K. Macdonald, Inc.
1531 Spruce St., Philadelphia 2

William E. McFadden
150 E. Broad St., Columbus 15, Ohio

R&T

MANUFACTURERS
Special Steel Equipment
Metal Cases – Cabinets
CONTRACTORS
Sheet Metal
Building Products
VENTILATION, AIR CONDITIONING

THE RIESTER & THESMACHER COMPANY
1526 W. 25TH ST. CHerry 1-0154
CLEVELAND, OHIO

SQUARE PULSE GENERATORS for the MILLIMICROSECOND to MICROSECOND RANGE

Model 100

Square Pulse Generator

PRICE: $395.00 F.O.B. New York

For Nuclear Pulse Work, Radar, TV, Wide Band Amplifiers, and in the design, calibration and servicing of fast electronic systems:

NOW—A new Square Pulse Generator with a rise time of one millimicrosecond (10^{-9} seconds) and a pulse width which can be varied from one millimicrosecond to several microseconds provides the ideal test instrument for fast electronic circuits. Both positive and negative pulses of a 100 volts maximum amplitude, into low impedance (such as 50 ohm cable) are generated; the pulse amplitude can be varied from 100 volts to .006 volts in 1 decibel steps by means of selector switches on the front panel. One, two, or more pulse outputs, each of which can be individually attenuated and delayed are available in various models.

For further details, write for bulletin P-1B or contact our Engineering Division.

ELECTRICAL AND PHYSICAL INSTRUMENT CORPORATION

Sales and Business Office
25 West 43 Street
New York 36, N.Y.
Telephone: LOngacre 4-2265

Engineering Division
42-19 27th Street
Long Island City, N.Y.
Telephone STillwell 4-6389

• To meet the growing demand from producers of light-weight, high-frequency Galvanometer movements, we have expanded our facilities designed to process Wire of 2S *Aluminum* . . . This wire can be supplied in diameters ranging from approximately .001 inch through .002 inch . . . *Anodized* with an exceptionally thin and flexible dielectric coating.

Also available: wires of aluminum alloys *enameled* as small as .001 inch diameter, to meet rigid specifications of resistance, size and straightness.

Write for Latest List of Products

SINCE 1901

SIGMUND COHN CORP.

121 So. Columbus Avenue • Mount Vernon, N.Y.

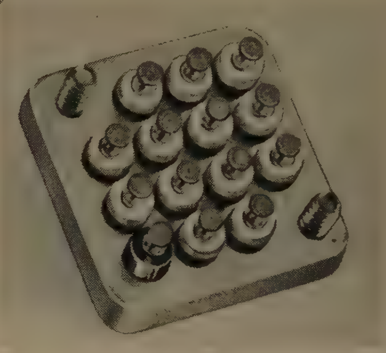
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 146A)

Hermetically Sealed Terminals

A new type of construction, an unusual sealing method, and a simple assembly technique are features which produce excellent performance and low cost in a new compression-type, hermetically sealed terminal manufactured by **Torwico Electronics, Inc.**, 961 Frelinghuysen Ave., Newark, N. J. Incorporated in a wide range of terminal header styles, the unit withstands severe vibration and shock without affecting the seal.

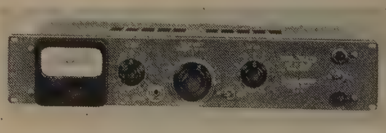


The unit consists of a tinned brass terminal stud, steatite insulators, and a silicone rubber seal. The silicone rubber is compressed between the steatite insulators and forms a seal by being displaced against an extruded hole in the cover plate and against the terminal electrode. The compression is held by an eyelet which is driven onto the end of the electrode and crimped securely. The eyelet serves as a lug for internal connection, and the entire assembly is only 7/32 inch diameter × $\frac{5}{8}$ inch long.

The temperature range is −65° to +500° F.

Signal Splitter

J. L. A. McLaughlin, P. O. Box 529, La Jolla, Calif., announces the development of a continuously-variable straight-sided selectivity converter, the type MCL-50 Signal-Splitter.



This new, selectivity converter is designed to provide exact jam-free bandwidths for every CW/SPEECH receiving condition. Its continuously variable filters provide bandwidths from 0.4 kc to 6.0 kc with 60 db cutoffs of from 500 to 600 cps. It can be used with any standard AM receiver and requires a rack-panel space of 3½ inches. It has self-contained power-supply and audio amplifier, with an output of 18 dbm/600 ohms.

(Continued on page 149A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 148A)

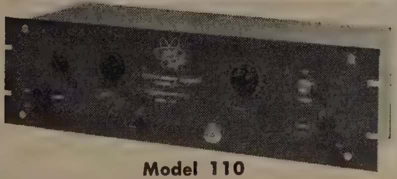
Literature on Shock Mounting Systems

Visualizer Bulletin No. 750, a new 16-page booklet published by **Robinson Aviation, Inc.,** Teterboro, N. J., illustrates the development of all-metal engineered mounting systems for maximum vibration isolation and shock protection of electronic equipment. The bulletin defines vibration and shock, shows the effect of vibration on equipment, what can be done about vibration, and the application of MET-L-FLEX (knitted stainless steel wire) as the resilient and damping element. It explains vibration control from theory to practice, and shows the development of the single and dual stage systems from the classical example of an equivalent mechanical system.

Visualizer's bulletin shows also a comparison between a conventional unit mounting and the many advantages of the Robinson engineered mounting system. Typical examples of engineered systems are shown including the "center of gravity type" and "internal type" of mounting designs. In addition, it illustrates the standard line of MET-L-FLEX unit mounts and unit mount bases designed and manufactured in accordance with existing specifications.

(Continued on page 150A)

NEW! Tubeless Regulated Dual DC Supply for **Transistor Application**



Model 110

Price $149.50

Features

- √ No Tubes-Long Life
- √ Negligible Warm-up Time
- √ Dual Output-Positive or Negative
- √ Continuously Variable Outputs
- √ Output #1—Triple Range at 60 ma 0-1.0, 10, 100 v.
- √ Output #2 0-100 v at 60 ma
- √ DC Impedance less than 100 ohms
- √ Line Regulated 95-125 v
- √ Ripple Less Than 0.01%
- √ Moderately Priced

Order Now for quick delivery or write for Bulletin B 1.

Electronic Research Associates

Dept. I 1, Box 29, Caldwell, N.J.

DON'T LET TOLERANCE or UNIFORMITY TROUBLE YOU!

"Lavite" Pressed Steatite Parts —offer these advantages

- Steward's interest in your parts starts with the material. That's why "Lavite" Steatite—a product of private research and development — can claim and prove individually superior qualities.
- "Lavite" Steatite, featuring low loss at high frequency, is kept under close laboratory control from raw ingredients to finished parts—therefore, a superior product at lowest cost.
- Parts of "Lavite" Pressed Steatite, made only by Steward, are closely controlled throughout manufacture to completely satisfy the dimensions for average requirements. For those applications demanding unusually close tolerances, the "Lavite" Steatite parts may be precision machined.
- You have a wide selection of specific properties from which to choose.
- Quantity? Just tell me how many and how soon.

Send your specifications for recommendations — Steward Engineers are your Engineers — no obligation.

D. M. STEWARD MANUFACTURING CO.

3605 Jerome Avenue Chattanooga, Tennessee

Sales Offices in Principal Cities

MINIATURIZATION

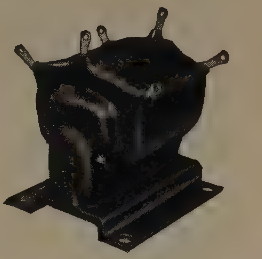
Thru constant research, Acme transformer engineers have developed designs, that save pounds and ounces in weight and provide long-life performance. We build miniature transformers by the thousands, each individually performance tested.

PRESSURIZED SEAL

Here is a transformer design with terminals sealed under pressure with a resilient sleeve that accommodates expansion and contraction of temperature changes.

PLASTIC COATING

This is one of a number of ways that plastic has been adapted to seal transformers or individual coils for service in humid atmospheres or under conditions which breed fungi.



Acme Electric
TRANSFORMERS

ACME ELECTRIC CORPORATION
445 WATER STREET • CUBA, NEW YORK
IN CANADA: ACME ELECTRIC CORP. LTD.
50 NORTH LINE RD. • TORONTO, ONT.

Another Step in

Getting to the bottom of things

At John E. Fast and Co., the watchdogs of quality are on the job twenty-four hours a day, in every stage of capacitor production. Recording controls indicate the smallest variations in heat, humidity, pressure and vacuum at each process point. Every precaution is taken to assure that environmental conditions are held at precise levels specified by our engineers.

The air in our winding rooms, for example, is continuously filtered so that no foreign particles may settle upon the windings themselves and contribute to ultimate failures. Similarly, capacitors are assembled, after vacuum impregnation, in clean rooms, where relative humidity is controlled at all times. These safeguards against inclusion of extraneous matter or moisture have resulted in increasingly satisfactory life and allied performances in Fast capacitors.

Supplementing this automatic vigilance is a completely equipped quality-control organization which functions at every process-stage from incoming inspection to final testing. At points where statistical control is applicable, our inspectors utilize techniques which comply with or exceed specifications laid down by the Armed Services Procurement Branches.

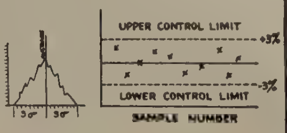
At final testing stations each production lot is given 100% test and inspection. Our belief is that a single failure out of a thousand may satisfy any sampling requirement, but it may be extremely costly to the consumer. Our investment in precision testing devices and extensive laboratory equipments is great, but its worth is reflected in our national reputation as producers of quality components.

Comprehensive reports are maintained by inspection centers located at strategic production points. These reports are summarized weekly, and it is quite significant to note that both the President of the Company and the Vice-President and Chief Engineer meet each Saturday morning with supervisors, engineers and military representatives to discuss the various problems indicated by process averages, and yield analyses for each production department.

In these days when every hour taken from the production job is spared grudgingly, we still take these hours every week to analyze and combat any threat to quality performance. Increasingly rigid specifications for dimensional and operational characteristics have shown very clearly that control of quality can be achieved and maintained only by rigorous application of all the techniques and tools we are employing.

No greater assurance of excellence may be given than that which has established our reputation. Our fixed objective will always be to maintain that reputation.

AVAILABLE LITERATURE
Tubular Capacitors in paper tubes. 65° or 85°C rating: SEC. I, CATALOG 25
Hermetically-Sealed Tubular Capacitors: SEC. VI, CATALOG 25
Subminiature Capacitors: Special Bulletin.
Jan C.25 Approved Capacitors: Refer to JAN C-25, "Specifications".



JOHN E. FAST & CO.
Capacitor Specialists For Over A Third of A Century
3177 North Pulaski Road, Chicago 41, Ill.
"WHEN YOU THINK OF CAPACITORS . . . THINK FAST"

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 149A)

High-Speed Magnetic Amplifiers

The Wallind-Pierce Corp., 1928 Pacific Coast Highway, Lomita, Calif., has designed an amplifier incorporating a new principle which permits rapid response without sacrifice of gain. Many circuits now employing electron tubes may be modified for the use of these magnetic amplifiers, thereby lengthening trouble-free life.

The following specifications are for one of three classes offered. Three supply frequencies have been tabulated. Amplifiers may be designed for any supply frequency the lower frequency limit being prohibitive size for a given power output, and the upper frequency limit being in the neighborhood of 20 kc.

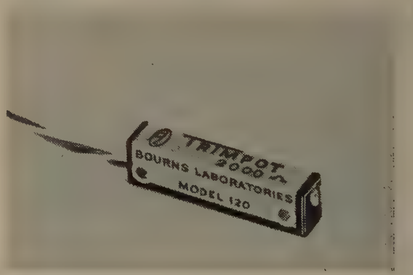
Weight—10 ounces.
Volume—4 cubic inches
Input Impedance—25,000 ohms maximum design value at full gain, higher at reduced gains.
Time Constant—25 milliseconds, reduced at lower gains.

Frequency	60 cps	400 cps	2,000 cps
Power Output, Watts.	1	7	35
Input Power, Milliwatts	0.10	0.16	0.25
Power Gain	10,000	50,000	150,000
Supply Voltage Design Value Range (volts)	10–75	10–500	10–1,000
Load Impedance Design Value Range (ohms)	100–5,600	15–30,000	3–30,000
Efficiency	50%	80%	95%
Price Subject to change without notice.	$220.00	$225.00	$240.00
Delivery	6 weeks	6 weeks	6 weeks

A phase detector weighing 4 ounces and occupying 1 cubic inch may be included in the input circuits if the amplifier is to be operated on ac signal inputs, at an additional cost of $15.00.

Sub-Miniature Wire-Wound Potentiometer

Bourns Laboratories, 6135 Magnolia Ave., Riverside, Calif., has designed a small potentiometer called Trimpot for precise circuit trimming in miniaturized equipment. The manufacturer claims Trimpot simplifies circuit design.

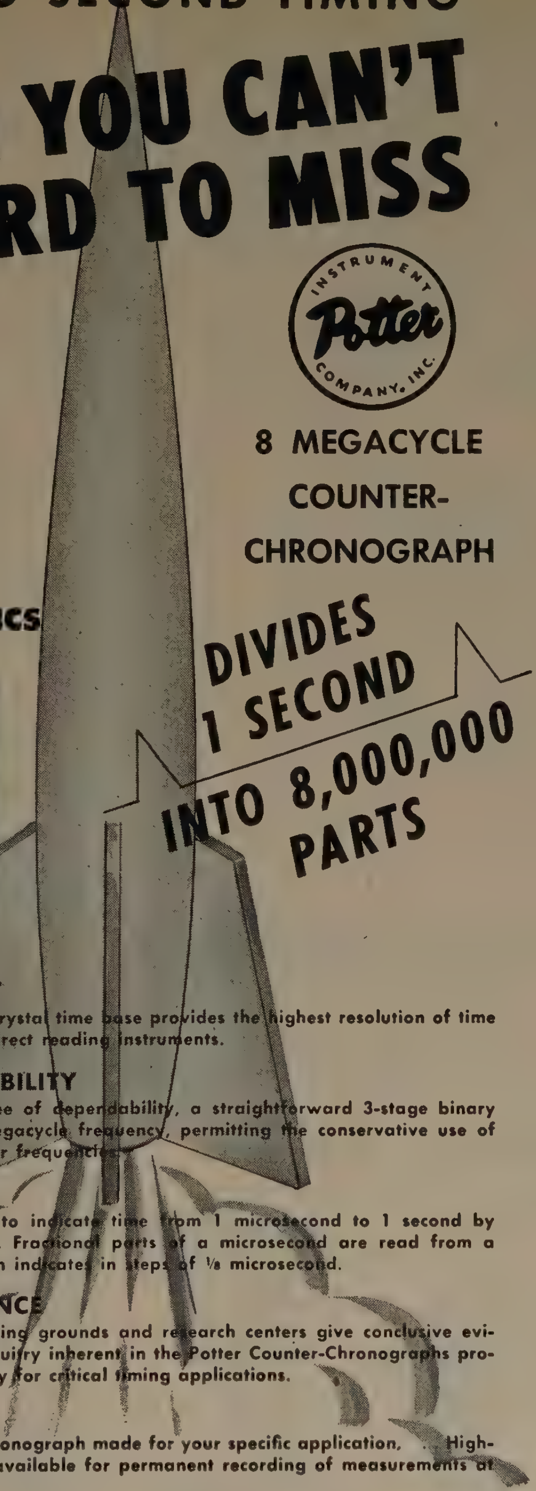


Accurate adjustments are made by turning the exposed slotted shaft with a screwdriver. Electrical settings are securely maintained during severe shock, vibration and acceleration. The Trimpot can be mounted individually or in stacked assemblies with two #2-56 screws through the eyelets in the body. Forty of these instruments occupy a space smaller than a standard pack of cigarettes.

(Continued on page 152A)

DEPENDABLE
1/8 MICRO-SECOND TIMING

WHEN YOU CAN'T AFFORD TO MISS

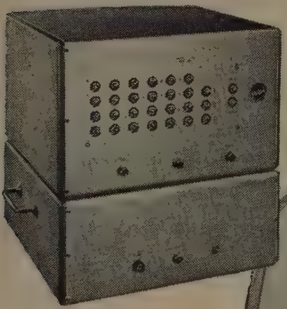


IN MEASURING:

- VELOCITY
- ACCELERATION
- DETONATION TIME
- DOPPLER FREQUENCIES
- PULSE CHARACTERISTICS

INSTRUMENT Potter COMPANY, INC.

8 MEGACYCLE COUNTER-CHRONOGRAPH



DIVIDES 1 SECOND INTO 8,000,000 PARTS

GREATER ACCURACY
The use of an 8 megacycle crystal time base provides the highest resolution of time measurement available in direct reading instruments.

COMPLETE DEPENDABILITY
To assure the highest degree of dependability, a straightforward 3-stage binary counter is used at the 8 megacycle frequency, permitting the conservative use of decade counters at the lower frequencies.

DIRECT READING
Digital registration is used to indicate time from 1 microsecond to 1 second by means of 6 Potter decades. Fractional parts of a microsecond are read from a 3-stage binary counter which indicates in steps of ⅛ microsecond.

PROVED PERFORMANCE
Ten years of service in proving grounds and research centers give conclusive evidence that the simplified circuitry inherent in the Potter Counter-Chronographs provides the maximum reliability for critical timing applications.

WIDE APPLICATION
There is a Potter Counter-Chronograph made for your specific application. . . . High-speed digital recorders are available for permanent recording of measurements at rates up to 150 per second.

WRITE FOR INFORMATION AND ENGINEERING DATA
Dept. 5-E.

Potter 109
POTTER
INSTRUMENT
COMPANY, INC.

115 CUTTER MILL ROAD
GREAT NECK, N. Y.

—PRECISION—
SERIES ES-500A
High Sensitivity—Wide Range
5" OSCILLOSCOPE
with PUSH-PULL
VERTICAL and HORIZONTAL
AMPLIFIERS
20 MV. per inch "V" Sensitivity
150 MV. per inch "H" Sensitivity

IMPORTANT FEATURES

★ **High Sensitivity, Extended Range, Push-Pull, Voltage Regulated Vertical Amplifier** — 10 cycles to 1 MC response. Input 2 megs. 22 mmfd.
★ **Frequency Compensated "V" Input Step Attenuator.**
★ **Vertical Phase-Reversing Switch.**
★ **Extended Range, High Sensitivity, Push-Pull Horizontal Amplifier** — 10 cycles to 1 MC response at full gain. Input ½ meg. and 20 mmfd.
★ **Linear Multi-Vibrator Sweep Circuit** — 10 cycles to 30 KC plus line and external sweep.
★ **4-Way Synch. Selection** — Internal Positive, Internal Negative, External and Line.
★ **"Z" Axis Modulation** terminal for blanking, etc.
★ **Internal, Phasable, 60 cycle Beam Blanking.**
★ **Sweep Phasing Control.** Wide-angle bridge circuit.
★ **Direct H and V Plate Connections;** all 4 plates.
★ **Audio Monitoring Phone Jacks.**
★ **High Intensity CR Patterns** through use of adequate high voltage power supply with 2X2 rectifier.
★ **Tube Complement and Circuit** — 6C4 "V" cathode follower, 6CB6 "V" amplifier. 6C4 "V" phase inverter. Push-Pull 6AU6's "V" CR driver. 7N7 "H" amplifier and phase inverter. Push-Pull 6AU6's "H" CR driver. 7N7 sweep oscillator. 5Y3 and 2X2 rectifiers. VR-150 voltage regulator. 5CP1/A CR Tube.
★ **7 Four-Way Lab. Type Input Terminals** — Take banana plugs, phone tips, bare wire or spade lugs.
★ **Light Shield and Mask** removable and rotatable.
★ **Extra Heavy-Duty Construction** and components to assure "Precision" performance.
★ **Heavy Gauge, Anodized, No-Glare, Aluminum Panel.**
★ **Fully Licensed** under W.E. Co. patents.

★ In louvred, black ripple, heavy gauge steel case. Size 8¼" x 14½" x 18". Complete with light shield, calibrating mask and instruction manual.................. **NET PRICE $173.70**

See this "PRECISION" 5" Oscilloscope on display and available at leading radio equipment distributors.

Precision Apparatus Co., Inc.
92-27 HORACE HARDING BLVD.
ELMHURST 12, N. Y.

Export: 458 B'way, N.Y.C., U.S.A. Cables: MORHANEX
In Canada: Atlas Radio Corp. Ltd., Toronto, Ontario

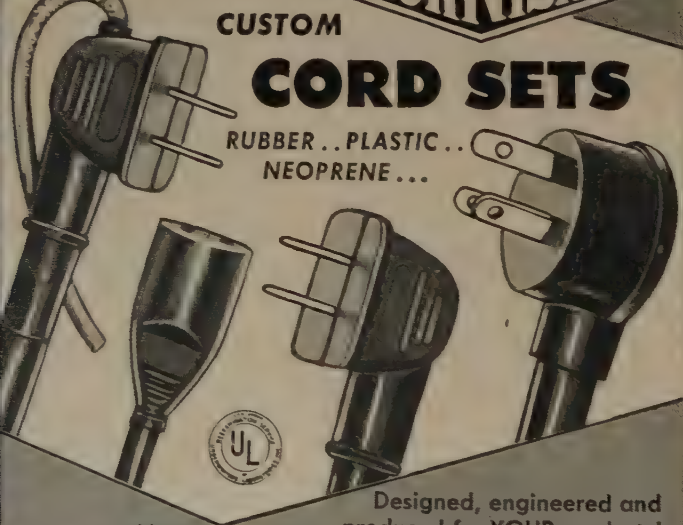
NEW "PARAFORMED" PAPER TUBES
MAKE YOUR COIL WINDING
EASIER! FASTER! BETTER!

- No sharp outside edges to cut wire
- Has full rigidity and physical strength
- Permits winding coils to closer tolerances
- No need for wedges to tighten wire
- Allows faster stacking of wound coils

ANY SIZE—SQUARE OR RECTANGULAR
Entirely new technique in tube making developed and perfected by PARAMOUNT now for the first time solves many coil winding problems, *yet costs you no more!* Hi-Dielectric. Hi-Strength. Kraft, Fish Paper, Acetate, Red Rope or any combination wound on automatic machines. Produced from stock arbors or special sizes engineered for you.
Write on Company letterhead for Stock Arbor List of over 2000 sizes

PARAMOUNT PAPER TUBE CORP.
617 LAFAYETTE STREET, FORT WAYNE 2, INDIANA
Manufacturers of Paper Tubing for the Electrical Industry Since 1931

GLUTTONS for PUNISHMENT
CORNISH
CUSTOM
CORD SETS
RUBBER . . PLASTIC . . NEOPRENE . . .



Also
"NOFLAME-COR"
The Television Hookup Wire

Designed, engineered and produced for YOUR products! For a delicate "walkie-talkie" or a huge arc welding unit . . . put your wire problems up to CORNISH experts!

"MADE BY ENGINEERS FOR ENGINEERS"
CORNISH WIRE CO., INC.
50 Church St. New York 7, N. Y.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 150A)

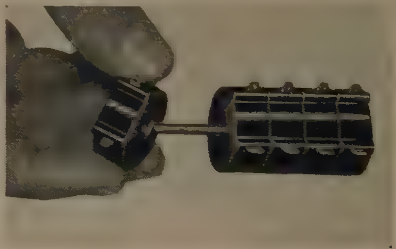
Resolution as low as 0.25 per cent is obtained over the twenty-five turn adjustment range. Superior electrical characteristics are achieved through the use of precious metal contacts and precision wire-wound resistors.

Trimpots are available in standard resistances of 250 to 10,000 ohms. Model 120, Size: 9/32×5/16×1¼ inches. Power is ¼ watt, standard resistances are 250, 500, 1,000, 2,000, 5,000, and 10,000 ohms. Acceleration 100 G's, vibration: 5–10 G's, 0–1,000 cps.

Hermetically Sealed Toroids

A new type "P" Toroid Coil, hermetically encapsulated in an especially tough plastic compound, has been announced by **Hycor Company, Inc.,** 11423 Vanowen St., North Hollywood, Calif.

These coils will withstand ambient temperatures of −55° C to 130° C; 95 per cent humidity—boiling salt water, and severe mechanical shock.



The small physical size makes them suited for use in miniature assemblies, and they may also be mounted compactly on a single screw.

Literature on this type (Bulletin TP) is available. It gives complete electrical characteristics.

Internal Magnetic Focus For TV Picture Tubes

Development of an "internal magnetic focus" gun which will permit the elimination of the external focus coil and ion trap magnet on television picture tubes was announced by **General Electric Co., Tube Dept.,** Syracuse, N. Y.

Use of the gun will also make possible sharper picture definition across the entire face of television screens.

The new gun contains an internal compensating focusing lens which maintains focus over a wide range of operating volt-

(Continued on page 154A)

the pioneer is the leader

PANORAMIC

PANORAMIC IS THE PIONEER in the transformation of spectrum content into visual spectographic displays . . . known as the "Panoramic Method" by the entire electronic field.

PANORAMIC LEADS the industry in producing instruments unexcelled for every application requiring high speed spectrum or waveform analysis. Whatever your problem, a Panoramic Analyzer solves it quickly, accurately.

PANORAMIC leads again with

Signal Switcher—SW1

Designed to apply alternately test and standard signals to Panoramic Sonic Analyzers. Enables frequency comparisons to within a fraction of a cycle. Used with the G-2 Sonic Response Indicator, it facilitates rapid comparisons of the frequency responses of amplifiers, filters, transmission lines, etc.

Panalyzor—Model SB-12 Type T-100

Designed specifically for applications requiring extreme resolution or demanding measurement of levels of signals spaced very closely in frequency or widely divergent in amplitude.

- Maximum Sweepwidth—100KC
- Maximum Resolution—10CPS
- Sweep Rates—30cps, 5 cps, 1 cps and 1 scan in 10 seconds

Inquiries invited on special Panoramic Spectrum Analysers

Panoramic Equipment on display at: National Conference of Airborne Electronics.

PANORAMIC
RADIO PRODUCTS, INC.

12 South Second Avenue, Mount Vernon, N.Y.
MOunt Vernon 4-3970

Linear Versus Logarithmic Meter Dials

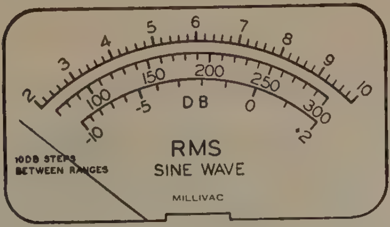
A New AC-VTVM Settles an Old Dispute

The new Millivac MV-12A AC voltmeter is an exceptionally versatile instrument. Designed to be used as an

AC-vacuum tube voltmeter,
AC-vacuum tube ammeter,
Scope-sensitizer
Current in addition to voltage wave shape observer

it also has the new "Engel" dial which satisfies both logarithmic and linear scale requirements.

A logarithmic volt-scale unavoidably has heavy non-linear compression of its divisions in the upper region making reading difficult and inaccurate even if the instrument itself has an inherent high accuracy. A linear volt-scale, on the other hand, causes heavy logarithmic compression of DB divisions at the low end which is equally undesirable. The new Engel dial shown below meets both logarithmic and linear requirements by having a suppressed zero in much the same manner in which logarithmic volt-scales are suppressed. The resultant spreading of both volt and DB divisions improves the reading comfort of the instrument and makes it superior to the old straight logarithmic system, not only on volts but even on DB. Best proof of the easy reading of the new dial is that without artificial galvanometer illumination it can be read from a longer distance than logarithmic dials with artificial illumination.



The MV-12A is an ideal scope-amplifier because it has no change-over switch for meter or amplifier operation. Simultaneous measuring and wave-shape observation is therefore possible. By plugging our MV-121 shunt box into the instrument, currents ranging from 1 µA to 3 A can also be measured and their wave shapes observed.

Highest measuring accuracy and convenience in servicing are obtained by *individual* range calibration-controls in both the MV-12A voltmeter and the MV-121 shunt box.

Specifications (MV-12A)

Total Ranges: 12, in 10 DB steps covering 700 µV to 1 kV.

Frequency: 20 CPS to 250 KC.

Accuracy: 2% of full scale throughout entire voltage and frequency range.

Calibration: RMS Sine Wave, with instrument measuring full wave average.
Amplifier Output: 3 V corresponding to full scale reading, 60 DB gain.
Tubes: 7-6AK5, 2-6V6GT, 1-0B2, 1-6X4.
MAX. SCOPE SENSITIVITY: ½ millivolt per inch on lowest 3 mV range.

MILLIVAC INSTRUMENT CORPORATION
BOX 997, SCHENECTADY, N.Y.
"Time Progresses And So Do We"

A BETTER TOOL for ELECTRONIC ENGINEER or RESEARCH SCIENTIST

MODEL A-2
TIME DELAY GENERATOR

• A precision instrument for the generation of accurate and variable time intervals from .8 to 100,000 μs.

- Low jitter
- High resolution
- High duty factor
- Direct reading
- Fast rise time

Also available: Model A-4—.00001 to 10 seconds.

Write for complete data:
Our bulletins I-A-2 and I-A-4

Rutherford ELECTRONICS CO.
3707 S. ROBERTSON BLVD., CULVER CITY, CALIFORNIA

R. F. CHOKES

Tiny-Rugged-Insulated

Immediate Delivery from Stock!

¼ to 150 microhenries

CONDOR RADIO MFG. CO.
2705 S. KRAMER
TUCSON, ARIZ.

AN/APR-4 LABORATORY RECEIVERS

Complete with all five Tuning Units, covering the range 38 to 4,000 Mc.; wideband discone and other antennas, wavetraps, mobile accessories, 100 page technical manual, etc. Versatile, accurate, compact—the aristocrat of lab receivers in this range. Write for data sheet and quotations.

We have a large variety of other hard-to-get equipment, including microwave, aircraft, communications, radar; and laboratory electronics of all kinds. Quality standards maintained. Get our quotations!

We will buy any Electronic Material at top prices. SCHOOLS —unload your dusty surplus for cash or credit.

ENGINEERING ASSOCIATES
434 PATTERSON ROAD
DAYTON 9, OHIO

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 152A)

ages. A simple shunt may be used to increase this range. No external focusing control requiring adjustment by the set owner is necessary. It is claimed that variations in picture tube anode voltage will not affect the quality of the picture focus.

The focusing and ion trap devices in the new gun use four tiny Carboloy Alnico 5" magnets. Three of the magnets, measuring ¼ inch in diameter and ⅝ inch in length, are used in the focus assembly and the fourth, measuring ⅛ inch in diameter and length, is used in the ion trap unit.

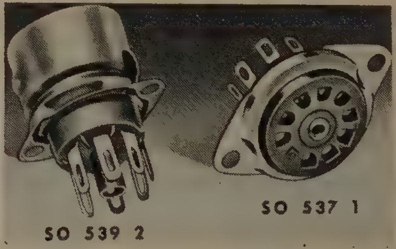
The 21JP4, GE's first tube in which the new gun has been incorporated, is a 21-inch rectangular, cylindrical-face tube with a 70° deflection angle.

This basic internal magnetic focus gun design used for television picture tube can also be applied to cathode-ray tubes for radar, industrial television or studio monitor equipment.

The gun may eventually be designed into tubes which can be used as replacement for tubes now in use.

Kel-F Miniature Tube Sockets

A new series of Chemelec 7 and 9-pin miniature tube sockets, utilizing injection-molded Kel-F insulators, has been announced by the **Fluorocarbon Products Div. United States Gasket Company,** 611 N. 10 St., Camden 11, N. J., manufacturers of feed-through insulators, crystal sockets, capacitor seals, stand-off insulators, trimmers, connectors, etc.



Kel-F, a thermoplastic Fluorocarbon polymer produced by M. W. Kellogg Co. has been found to be a suitable material for high performance tube sockets where high or low ambient temperatures and frequency stability are problems.

Its electrical properties are excellent, except in the uhf range. Its dielectric constant is 2.3. It has wide service temperature range, from a low of −320° F to +390° F. Water absorption is zero by ASTM Test.

Physically tough, resilient, it is unaffected by thermal or mechanical shock and vibration in installation and service. It is impervious to oil and most chemicals and is non-flammable.

Chemelec Kel-F insulated 7 and 9-pin miniature tube sockets are furnished in both saddle and can types.

(Continued on page 157A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 154A)

Selenium Regulator

International Rectifier Corp., 1521 E. Grand Ave., El Segundo, Calif., has announced the development of a series of selenium regulators. They are recommended for the regulation of relatively low dc voltages. For example, Type D-568 is recommended for the regulation of dc voltages in the order of 1.5 volts. This unit is a regular production item consisting of two specially processed selenium plates connected in series on a mounting bracket, and constitutes the basic design of a series of selenium regulators for other voltages.

For operation, the regulator is connected in shunt with the load. A voltage dropping resistor is connected in series with the source voltage and the load. Regulation is accomplished by utilizing the forward characteristic. The voltage across the voltage dropping resistor varies inversely with changing load current and the desired voltage is maintained.

Two other types currently available, Type D-923 and Type D-1064, are recommended for regulation of 2.0 volts and 3.0 volts dc respectively. Regulators for higher voltages can be produced by adding more specially processed selenium plates to the basic design.

Coil Kit

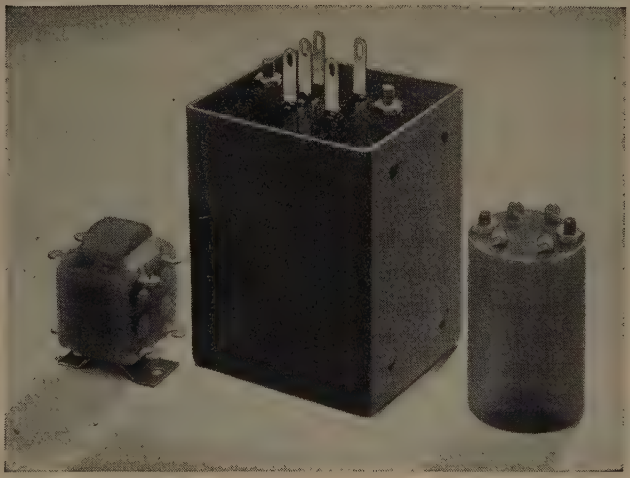
As an aid to design engineers, laboratory technicians, and others engaged in developing prototypes and pilot models, **Cambridge Thermionic Corp.,** 445 Concord Ave., Cambridge 38, Mass., has made available a new coil kit.

This kit contains 10 coils of the LS 6 size, type C, with silicone fibreglas collars. The coils cover a range of from 2 microhenries to 800 microhenries, the range of each individual slightly overlapping the next coil in the scale.

(Continued on page 158A)

Kenyon

SPECIAL Transformers Have Many Applications



"Ken-Seal" Moulded Units

There are many transformer applications in which hermetic sealing can be achieved more desirably than with metal casings. This is especially true where weight, space and cost are important factors. To satisfy this demand Kenyon has introduced "Ken-Seal" moulded transformers which meet all government specifications. The moulded process was chosen in preference to dipping or encapsulation because it produces a finished product of controllable, definite dimensions, with a uniform amount of sealing thickness.

An easily mixed casting resin is used, with cast separable moulds for large production or small strippable moulds for smaller quantities. This simple process insures uniformity and efficient sealing at low cost. "Ken-Seal" moulded units may be the answer to some of your transformer problems. Send us your inquiries. We're in production now.

No matter what your transformer requirements may be contact Kenyon first. Our engineers will endeavor to show you how you can increase efficiency at low cost by choosing a transformer from the complete Kenyon line.

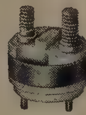
KENYON TRANSFORMER CO., Inc.

840 Barry Street, New York 59, N. Y.

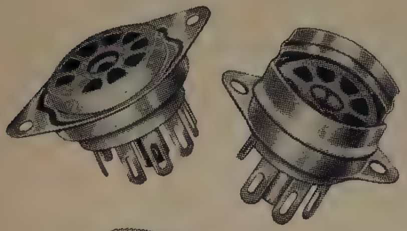
ELECTRICAL INSULATION THAT WILL TAKE 2000° F. FOR BRIEF PERIODS!

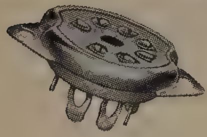
Aircraft fire detection apparatus needs that. Here is the Mycalex glass-bonded mica part that has it.

Mycalex 410 molded with steel ring inserts for thermo-coupling device produced by Thomas A. Edison, Inc.



● For permanent endurance Mycalex can take 650°F. continuously without heat distortion or any other injury.





ACTUAL SIZE

Mycalex is superior for high voltage, high frequency components that must operate in small spaces.

For example, tube sockets like these — now used in over 60% of all television receiver tuners. — Manufactured and sold by Mycalex Tube Socket Corporation, Clifton, N. J.

If your insulation must take heat or get rid of heat, investigate Mycalex!

WRITE FOR ENGINEERING DATA BOOK

SINCE 1919
MYCALEX
THE INSULATOR ®

MYCALEX CORPORATION of AMERICA
World's Largest Manufacturer of Glass-bonded Mica Products
Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.
GENERAL OFFICES AND PLANT
111 CLIFTON BOULEVARD, CLIFTON, N. J.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 157A)

The kit comes complete with mounting hardware and also contains a chart on the inside top cover listing all data about the coils of interest to the designer—information such as inductance range, wire size number of turns, Q value. Coils are color-coded for ready reference to this chart thus making it easy to order in quantity and simplifying the task of the designer at the point where specifications have been determined. All coils are slug tuned.

In planning prototypes of electronic equipment, design engineers should find this kit helpful. $7.95 F.O.B. Cambridge, Mass.

High-Fidelity Catalog

A new catalog, #CM-53, describing the 20-watt Masco Concert Master high-fidelity amplifier with remote pre-amplifier, model CMR-20, is now available from **Mark Simpson Mfg. Co.,** 3228 Forty-Ninth Street, Long Island City 3, N. Y.

The Concert Master and its remote pre-amplifier provide realism of tone, with harmonic or intermodulation distortion of less than 0.2 per cent at 20 watts, and from 20 to 40,000 cps. Frequency response is 10 to 50,000 cps $\pm\frac{1}{2}$ db at 20 watts. Response is better than 5 to 140,000 cps $\pm 1\frac{1}{2}$ db at 1 watt.

(Continued on page 159A)

ELECTRONICALLY REGULATED
LABORATORY
POWER SUPPLIES

BENCH
MODEL 25

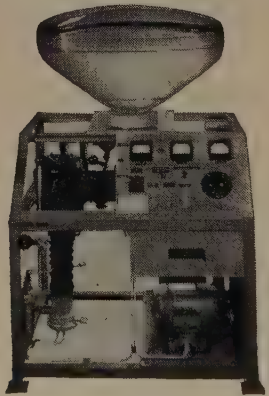
STABLE
DEPENDABLE
MODERATELY PRICED

- INPUT: 105 to 125 VAC, 50-60 cy
- OUTPUT #1: 200 to 325 Volts DC at 100 ma regulated
- OUTPUT #2: 6.3 Volts AC CT at 3A unregulated
- RIPPLE OUTPUT: Less than 10 millivolts rms

WIDTH 14″
DEPTH 6″
HEIGHT 8″
WT: 17 LBS.

For complete information write for Bulletin N-5S

LAMBDA ELECTRONICS CORPORATION
CORONA NEW YORK



TELEVISION TUBE ALUMINIZER

Laboratory or semi-production model complete with tube gasket, filament supply and gauges.

Large production machines also available.

Write us for literature giving complete details

OPTICAL FILM ENGINEERING CO.
2731-37 North Sixth Street
Philadelphia 33, Pennsylvania

There is Always One Leader in Every Field

BODNAR INDUSTRIES, Inc.
leads in the field of
TRANSILLUMINATED PLASTIC LIGHTING PLATES
BECAUSE OF *Quality* • *Uniformity* • *Performance*
Design & Layout "Know-How Service"
Quantity Production Promptly

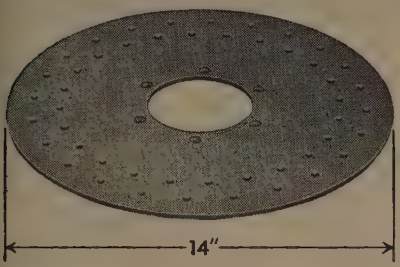
NEW YORK —19 Railroad Ave., New Rochelle (Home Office)
TEXAS —Jefferson Tower Building, Dallas
CALIFORNIA—11056 Cumpston St., N. Hollywood
CANADA —313 Montreal Trust Bldg., 67 Yonge St., Toronto

SPECIMEN PANEL MIL-P-7788 (AN-P-89) SENT ON LETTERHEAD REQUEST

ELECTRICAL INSULATION
THAT CAN BE MADE TO THE
SAME TOLERANCES
AS STEEL

YES, we *do* mean *any* tolerances that can be produced in steel.

For example:



Two of these 14" Mycalex 400 discs revolve with only .004" clearance.

Dimensionally stable, too. Mycalex *stays* accurate.

Mycalex glass-bonded mica is found in *HIGH PRECISION* electrical components.

WRITE FOR ENGINEERING DATA BOOK

SINCE 1919
MYCALEX
THE INSULATOR ®

MYCALEX CORPORATION of AMERICA
World's Largest Manufacturer of Glass-bonded Mica Products
Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.
GENERAL OFFICES AND PLANT
111 CLIFTON BOULEVARD, CLIFTON, N. J.

News—New Products

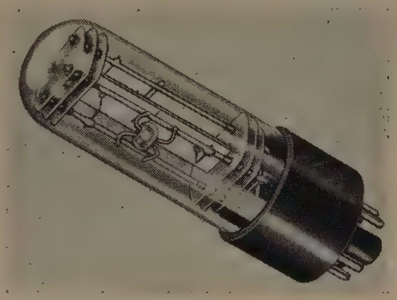
These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 158A)

An Eight position switch selects proper equalization for all records, radio tuner, TV tuner, tape recorder. Fletcher-Munson compensated loudness control, separate bass and treble controls and three separate input level adjustments are provided. Special "roll-off" input of the basic amplifier overcomes turntable rumble and other externally generated noises.

Stabilized Quartz Crystals

The James Knights Co., Sandwich, Ill., has utilized an adaptation of tube manufacturing techniques to the production of precision crystals. As a result, they now have available crystals with a varied range of low frequencies and flexible characteristics.



Two of these types of crystals are enclosed in hermetically sealed glass holders. Both are wire mounted in a 6V6GT envelope with an octal base. They are available with gold or silver plated crystals.

The G-9J has a frequency range from 1.2 to 10 kc, with a frequency tolerance of ±0.03 per cent at −40° to +70° C. The capacity ratio ranges from approximately 1,000 to 200.

Either of the above types is available within a varied range of frequencies and characteristics.

For detailed information concerning any application you may need, write to the company.

Shielding Paint for C-R Tubes and Meters

Micro-Circuits Co., Dept. PI, New Buffalo, Mich., announces production of their new RS12 Conductive Shielding Paint for static shielding of C-R tubes, meters, high-voltage power supplies, high-voltage generator windings, etc. Special advantages claimed include very low cost, high conductivity, excellent adhesion and durability, heat resistance, complete quality control, very mild pigment settling, and a viscosity suitable for spraying as received.

Packing includes most conventional containers ranging from four-ounce bottles which will be sold through jobber channels, to five-gallon drums for industrial use.

For data and price sheet, MR11, contact the company.

(Continued on page 165A)

IS THERE ANYTHING
WRONG WITH
MYCALEX?

YES

It's inelastic
- **But inserts won't shake loose.**

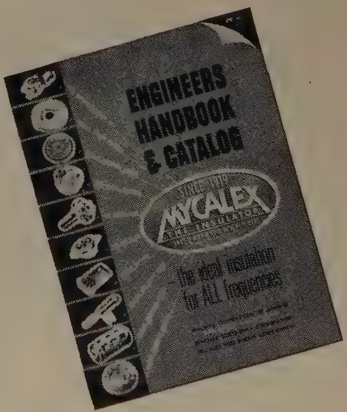
It has high density
- **But permits reduction of overall size and weight.**

It has no color appeal
- **But has certain surface finish interest.**

MYCALEX GLASS-BONDED MICA
IS THE ONLY
CERAMOPLASTIC

The only material combining most of the best properties of ceramics and plastics, plus some of its own.

GET THE FULL, FRANK STORY



WRITE FOR ENGINEERING DATA BOOK

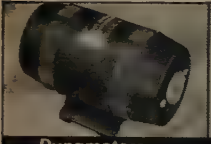
SINCE 1919
MYCALEX
THE INSULATOR ®

MYCALEX CORPORATION of AMERICA
World's Largest Manufacturer of Glass-bonded Mica Products
Executive Offices: 30 Rockefeller Plaza, New York 20, N.Y.
GENERAL OFFICES AND PLANT
111 CLIFTON BOULEVARD, CLIFTON, N. J.

COMPACT
DEPENDABLE
EFFICIENT
Rotary Power
by Carter

THE NEW
Custom
DC-AC CONVERTER

These latest of all Carter DC to AC Converters are specially engineered for professional and commercial applications requiring a high capacity source of 60 cycle AC from a DC power supply. Operates from storage batteries, or from DC line voltage. Three "Custom" models, delivering 300, 400, or 500 watts 115 or 220 V. AC. Wide range of input voltage, 12, 24, 32, 64, 110 or 230 V. DC. Unequalled capacity for operating professional recording, sound movie equipment and large screen TV receivers. Available with or without manual frequency control feature.


Dynamotors

Genemotors

Magmotors

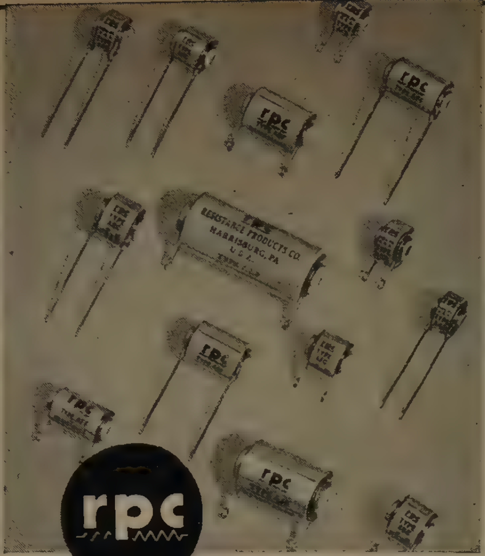
Inductor Alternators

MAIL COUPON FOR CATALOG

Carter Rotary Power Supplies are made in a wide variety of types and capacities for communications, laboratory and industrial applications. Used in aircraft, marine, and mobile radio, geophysical instruments, ignition, timing, etc. MAIL COUPON NOW for complete Dynamotor and Converter Catalogs, with specifications and performance charts on the complete line.

Carter MOTOR CO.
2645 N. Maplewood Ave.
Chicago 47

Carter Motor Co.
2645 N. Maplewood Ave., Chicago 47
Please send new catalogs containing complete information on Carter "Custom" Converters and other Rotary Power Supplies.
Name__________
Address__________
City__________State__________



Leading Manufacturers Rely on RPC for Quality and Quantity in Precision Resistors!

Within a few years RPC has attained a position of leadership in the manufacture of precision wire wound resistors. This is no accident. It is the result of STRINGENT *control of quality*—use of the *finest available materials*—test equipment and standards that are matched only by a few outstanding laboratories.
RPC Precision Resistors meet Government specifications. They are acceptable for all types of equipment—test instruments, electronic computers and scientific equipment. Requirements of Jan-R-93, Mil-R-93A are fully met. Advanced methods of production have made possible large or small orders at reasonable cost with prompt delivery. Write for catalog and helpful information about RPC's resistors.

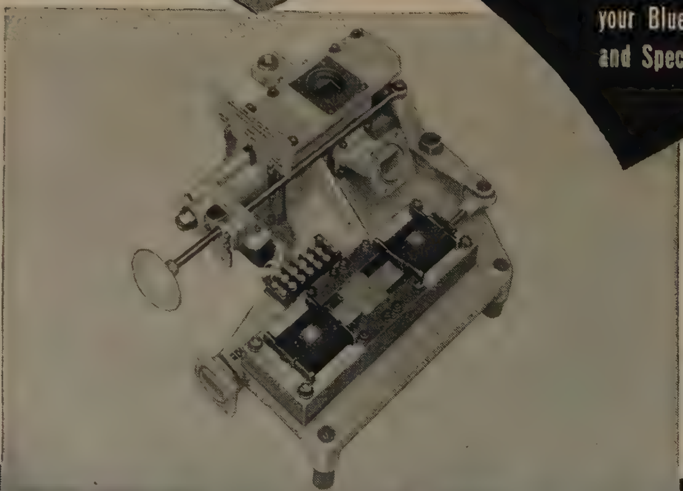
RESISTANCE PRODUCTS CO.
714 Race St. Harrisburg, Penna.
Precision Wire Wound—High Voltage—High Megohm—High Frequency—Hermetically Sealed—QUALITY RESISTORS

RPC Type	Government Specification		Dimensions		Resistance Ohms			Watts	
					Min.	Max. with Low T.C. Alloy			
	Jan-R-93	Mil-R-93A	Length	Diameter		.0015 Dia.	.001 Dia.	Jan or Mil	Comm'l
AFB*	RB10	RB15	15/32	17/32	0.1	.160 meg	.650 meg	.25	.5
AGB*	RB10	RB15	15/32	5/8	0.1	.235	1.0	.25	.5
AFC*	RB11	RB16	5/8	17/32	0.1	.225	1.0	.33	.5
AGC*	RB11	RB16	5/8	5/8	0.1	.330	1.5	.33	.5
AFF*	RB12	RB17	1	17/32	0.1	.475	2.0	.5	1
AGF*	RB12	RB17	1	5/8	0.1	.700	3.0	.5	1
AJS	RB13	RB18	1-9/32	11/16	0.1	1.25	5.0	.5	1
ALP	RB14	RB19	2-1/16	13/16	0.1	2.5	10.0	1	2

*NOTE—Can be furnished with 1-1/2" long 20 gauge tinned wire leads instead of lug terminals. Suffix "W" after type denotes wire leads.

NRK

Microwave Assemblies, Radar Components, and Precision Instruments . . . manufactured to your Blueprints and Specifications.



N.R.K. MFG. & ENGINEERING CO.
4601 WEST ADDISON STREET • CHICAGO 41, ILL. • SPring 7-2970

IRE DIRECTORY QUESTIONNAIRE

Send to: Industry Research Div., Institute of Radio Engineers
1475 Broadway, 22nd Floor, New York 36, N. Y.

Date ______________

Firm Name: ______________ Phone No. ______________

Address: ______________ Place ______________ Zone ______ State ______________

Name of: Chief Engineer ______________

Advertising Manager ______________

4-53 Purchasing Agent ______________

Method to be used by firms to indicate roducts manufactured or services ren- ered. Please read the entire question- aire. Products are grouped beneath basic eadings to facilitate location.

Do not check products that you do not anufacture for sale to the industry.

Components manufactured for incorporation in your own end products (and not intended for sale) should not be listed, as this will only result in annoyance to you, and the firms who make inquiries concerning product availability.

If, after a thorough examination of this form, you do not find a listing for your products, a short description and literature or catalogs that you have should be attached and returned to us.

After checking off the products, please fill in full data on your firm name and address, and mail the entire form to: Frank MacAloon, Industry Research Div., Institute of Radio Engineers, 1475 Broadway, New York 36, N. Y.

Industry Research Division Information Service

. Audio Frequency Equipment.

1 Amplifiers.
- 05 ☐ Decade amplifiers
- 10 ☐ DC amplifiers
- 15 ☐ Dynamic noise suppressors
- 20 ☐ Hearing aid
- 25 ☐ High fidelity
- 30 ☐ Inter-coms
- 35 ☐ Phonograph pre-amplifiers
- 40 ☐ Power amplifiers—recording
- 45 ☐ Public address

2 Attenuators.
- 05 ☐ Decade
- 10 ☐ Impedance matching
- 15 ☐ Volume controlling

3 Equalizers.
- 05 ☐ Dialogue equalizers
- 10 ☐ Line equalizers
- 15 ☐ Magnetic recording
- 20 ☐ Recording diameter equalizers
- 25 ☐ Sound effect equalizers

4 Filters.
- 05 ☐ Band pass & band rejection
- 10 ☐ Loudspeaker dividing networks
- 15 ☐ Variable Band Pass

5 Industrial Sound Systems.
- 05 ☐ Complete systems
- 10 ☐ Installation & rental contractors

6 Jacks, Jack Fields & Plugs.
- 05 ☐ Jacks
- 10 ☐ Jack fields
- 15 ☐ Patch cords
- 20 ☐ Plugs

7 Loudspeakers & Headphones.
- 05 ☐ Commercial grade loudspeakers
- 10 ☐ Headphones
- 15 ☐ High-frequency loudspeakers
- 20 ☐ Low-frequency loudspeakers
- 25 ☐ Wide-range, 2 & 3 way systems

08 Microphones & Stands.
- 05 ☐ Carbon
- 10 ☐ Condenser
- 15 ☐ Crystal
- 20 ☐ Dynamic
- 25 ☐ Velocity
- 30 ☐ Microphone stands

09 Phonographs, Pick-ups, Record Changers, etc.
- 05 ☐ Phonograph motors
- 10 ☐ Pick-ups—crystal
- 15 ☐ Pick-ups—dynamic
- 20 ☐ Pick-ups—magnetic
- 25 ☐ Pick-ups—reluctance
- 30 ☐ Playback arms
- 35 ☐ Record changers
- 40 ☐ Record players
- 45 ☐ Styli-diamond
- 50 ☐ Styli-metallic
- 55 ☐ Styli-sapphire
- 60 ☐ Tape phonographs & playback equipment

10 Recording Accessories & Supplies.
- 05 ☐ Blank disks
- 10 ☐ Cutting heads
- 15 ☐ Cutting styli
- 20 ☐ Magnetic recording, playback & erase heads
- 25 ☐ Magnetic recording tape-acetate base
- 30 ☐ Magnetic recording tape-paper base
- 35 ☐ Magnetic recording wire
- 40 ☐ Stylus resharpening
- 45 ☐ Suction pumps & equipment
- 50 ☐ Tape splicing equipment

11 Recording Equipment.
- 05 ☐ Disk recorders
- 10 ☐ Embossing types of recorders
- 15 ☐ Magnetic tape recorders
- 20 ☐ Magnetic wire recorders

2. Broadcasting: Both Aural & Visual; Receivers, Transmitters & Associated Equipment.

12 Antennas & Accessories.
- 05 ☐ AM broadcast transmitting
- 10 ☐ FM broadcast transmitting
- 15 ☐ TV broadcast transmitting
- 20 ☐ Supporting towers
- 25 ☐ Tower lighting equipment
- 30 ☐ Tower erection & maintenance service

13 Monitor Equipment.
- 05 ☐ Frequency
- 10 ☐ Modulation
- 15 ☐ Remote Control Monitors
- 20 ☐ Video monitors

14 Receivers.
- 05 ☐ AM Broadcast
- 10 ☐ AM Shortwave
- 15 ☐ FM Broadcast
- 20 ☐ TV Broadcast
- 25 ☐ TV Boosters
- 30 ☐ TV Color adapters
- 35 ☐ TV Tuners

15 Services for the Broadcaster.
- 05 ☐ Frequency measurement
- 10 ☐ Packaged program services
- 15 ☐ Transcription libraries

16 Studio Equipment.
- 05 ☐ Consoles & speech input equip.
- 10 ☐ TV Cameras
- 15 ☐ TV camera control equipment
- 20 ☐ TV Film projectors
- 25 ☐ TV Studio lighting equipment
- 30 ☐ Turntables

17 Transmitters.
- 05 ☐ AM Broadcast
- 10 ☐ FM Broadcast
- 15 ☐ TV Broadcast
- 20 ☐ Relay broadcast & STL equip.

3. Communications: All non-broadcast forms of communication; Amateur, Emergency, Facsimile, Mobile, etc.

18 Aircraft & Airport Equipment.
05 ☐ Airborne receivers
10 ☐ Airborne transmitters
15 ☐ Airport receivers
20 ☐ Airport transmitters
25 ☐ GCA Equipment, etc.

19 Amateur Equipment.
05 ☐ Antennas & antenna accessories, rotators, etc.
10 ☐ Receiving equipment
15 ☐ Transmitters

20 Carrier Current Equipment.
05 ☐ Complete terminal equip.
10 ☐ Installation & maintenance
15 ☐ Repeat & relay equip.

21 Emergency Communications Equipment.
05 ☐ Despatching equipment
10 ☐ Walkie-talkies

22 Facsimile Equipment.
05 ☐ Receiving equipment
10 ☐ Sensitized paper
15 ☐ Transmitting equipment

23 Marine Equipment.
05 ☐ Contract installers
10 ☐ Pleasure craft radiotelephones
15 ☐ Shipborne communications equip.

24 Mobile Equipment.
05 ☐ Antennas
10 ☐ Central Station receivers
15 ☐ Central Station transmitters
20 ☐ Citizen Radio
25 ☐ Mobile receivers
30 ☐ Mobile transmitters
35 ☐ Selective Calling equipment

25 Point-to-Point Equipment.
05 ☑ Antennas & towers
10 ☐ Receivers
15 ☐ Transmitters

4. Component Parts

26 Antennas & Accessories.
05 ☐ All-wave receiving
10 ☐ Dummy
15 ☐ Feeder line
20 ☐ Indoor types
25 ☐ Isulators
30 ☐ Lightning arrestors
35 ☐ Mounting hardware
40 ☐ Small towers

27 Batteries.
05 ☐ Dry batteries
10 ☐ Mercury batteries
15 ☐ Storage batteries—lead-acid
20 ☐ Storage batteries—nickel-alkali

28 Blowers & Cooling Fans.
05 ☐ Air wheels & housings
10 ☐ Complete blower assemblies
15 ☐ Fan blades

29 Cabinets, Consoles, & Enclosures.
05 ☐ Metal cabinets
10 ☐ Metal Relay Rack Panels
15 ☐ Moulded plastic cabinets
20 ☐ Wood cabinets

30 Capacitors: Fixed.
05 ☐ Ceramic
10 ☐ Electrolytic
15 ☐ Metallized paper
20 ☐ Mica
25 ☐ Oil filled
30 ☐ Paper
35 ☐ Plastic insulated
40 ☐ Silvered mica
45 ☐ Vacuum

31 Capacitors: Variable.
05 ☐ Neutralizing
10 ☐ Precision variable
15 ☐ Temperature compensating
20 ☐ Trimmers
25 ☐ Tuning
30 ☐ Vacuum

32 Chassis & Racks.
05 ☐ Aluminum chassis
10 ☐ Steel chassis
15 ☐ Relays racks & cabinets

33 Coils.
05 ☐ Audio frequency chokes
10 ☐ Deflection yokes
15 ☐ Focusing coils
20 ☐ RF chokes
25 ☐ Toroids
30 ☐ Tuning

34 Connectors.
05 ☐ AN Standard types
10 ☐ Co-axial
15 ☐ Microphone
20 ☐ Multiple circuit connectors
25 ☐ Power
30 ☐ Slip ring and commutating connectors

35 Converters.
05 ☐ DC Choppers
10 ☐ Vibrators

36 Cores, Complete.
05 ☐ Ferrites
10 ☐ Pre-formed, spirally wound
15 ☐ Powdered metal

37 Crystals & Accessories.
05 ☐ Crystal holders
10 ☐ Crystal ovens
15 ☐ Oscillating quartz crystals
20 ☐ Piezo electric
25 ☐ Tourmaline

38 Filters.
05 ☐ RF noise reduction
10 ☐ Mechanical

39 Fuses & Fuse Holders.
05 ☐ Fuses
10 ☐ Fuse Holders

40 Magnetic Amplifiers.
05 ☐ Complete assemblies

41 Magnets.
05 ☐ Electro
10 ☐ Permanent

42 Meters (Indicating Instruments).
05 ☐ Ammeters
10 ☐ Elapsed time
15 ☐ Frequency indicating
20 ☐ Galvanometers
25 ☐ Micro-ammeters
30 ☐ Milli-ammeters
35 ☐ Voltmeters
40 ☐ Volume level, (DB & VU)
45 ☐ Wattmeters & watt hour meters

43 Motors & Motor-Generators.
05 ☐ Blower & fan motors
10 ☐ Dynamotors
15 ☐ Frequency changers
20 ☐ Motor-generators
25 ☐ Synchronous motors
30 ☐ Timing motors

44 Pilot Lights & Assemblies.
05 ☐ Brackets, jewels, mounts, socke etc.
10 ☐ Incandescent lights
15 ☐ Neon lights

45 Power Supplies.
05 ☐ High voltage, (kilovolt)
10 ☐ Low voltage
15 ☐ Medium voltage
20 ☐ Primary power sources, fuel-engine driven
25 ☐ Voltage regulated power source

46 Printed Circuits.
05 ☐ Etched or screened prewired chassis
10 ☐ Printed electronic assemblies
15 ☐ Solder dipped prewired chassis

47 Rectifiers, Metallic.
05 ☐ Copper oxide, etc.
10 ☐ Selenium
15 ☐ Silicon

48 Relays.
05 ☐ Co-axial
10 ☐ D'Arsonval
15 ☐ Frequency selective
20 ☐ Hermetically sealed
25 ☐ Keying
30 ☐ Mercury contact
35 ☐ Polarized
40 ☐ Power control & overload
45 ☐ Stepping
50 ☐ Telephone
55 ☐ Time delay

49 Resistors.
05 ☐ Carbon fixed, moulded
10 ☐ Carbon, variable
15 ☐ Deposited carbon
20 ☐ Potentiometers
25 ☐ Rheostats
30 ☐ Vacuum sealed
35 ☐ Very high megohm

40 ☐ Wirewound, variable
45 ☐ Wirewound, fixed
50 ☐ Wirewound, precision

0 Semi-Conductors.

05 ☐ Germanium diodes
10 ☐ Transistors

1 Sockets.

05 ☐ Capacitor, plug-in sockets
10 ☐ Receiving tube
15 ☐ Transmitting tube
20 ☐ UL approved industrial types

2 Switches.

05 ☐ Band
10 ☐ Coaxial
15 ☐ Key
20 ☐ Mercury
25 ☐ Momentary contact
30 ☐ Power
35 ☐ Precision snap-acting
40 ☐ Rotary
45 ☐ Slide
50 ☐ Spring-return
55 ☐ Thermally operated
60 ☐ Thermostats
65 ☐ Toggle & push button

3 Telegraph Keys.

05 ☐ Manual
10 ☐ Mechanical high speed
15 ☐ Semi-automatic

4 Transformers.

05 ☐ Audio
10 ☐ Hermetically sealed
15 ☐ Horizontal output & flyback
20 ☐ Power components
25 ☐ Pulse
30 ☐ Radio Frequency
35 ☐ Voltage regulating

5 Vacuum Tubes, Receiving.

05 ☐ Cathode-Ray
10 ☐ Miniature
15 ☐ Standard types, glass & metal
20 ☐ Sub-miniature

6 Vacuum Tubes, Rectifiers & Special Purpose.

05 ☐ Electrometer tubes
10 ☐ Geiger-Mueller
15 ☐ Grid-controlled rectifiers
20 ☐ Mercury vapor rectifiers
25 ☐ Phototubes
30 ☐ Pirani tubes
35 ☐ Thyratrons
40 ☐ Vacuum rectifiers, receiving
45 ☐ Vacum rectifiers, transmitting
50 ☐ Voltage regulators & balasts

7 Vacum Tubes, Transmitting.

05 ☐ Air-cooled power tubes
10 ☐ Iconscopes
15 ☐ Image orthicons
20 ☐ Klystrons
25 ☐ Magnetrons
30 ☐ Monoscope tubes
35 ☐ Water-cooled power tubes

8 Voltage Regulators.

05 ☐ Automatic
10 ☐ Manually operated
15 ☐ Varistors

5. Applications of Electronics, Industrial, Medical & Military.

59 Computers & Counters.

05 ☐ Analog to digital converters
10 ☐ Computers, analog
15 ☐ Computers, digital
20 ☐ Counters, continuous
25 ☐ Counters, pre-set

60 Electronic Control Equipment.

05 ☐ Burglar-alarm & protective systems
10 ☐ Combustion & smoke-nuisance controls
15 ☐ Production control, counting & sorting equipment
20 ☐ Variable speed controls

61 Geophysical Apparatus.

05 ☐ Amplifiers
10 ☐ Complete exploration equipment
15 ☐ Control equipment
20 ☐ Microphones
25 ☐ Recording galvanometers
30 ☐ Transformers

62 Induction Heating Equipment.

05 ☐ Brazing, soldering & welding
10 ☐ Di-electric heating
15 ☐ Induction heating

63 Medical Equipment.

05 ☐ Cardiographs
10 ☐ Diathermy
15 ☐ Electronic cauterizing
20 ☐ Electro-encephalographs
25 ☐ Stimulators

64 Nuclear Equipment.

05 ☐ Pulse count integrators
10 ☐ Radiation detectors
15 ☐ Scalers

65 Servo-Mechanisms.

05 ☐ Servo amplifiers
10 ☐ Gears, gear-trains, etc.
15 ☐ Servo motors & generators

66 Telemetering Equipment.

05 ☐ Data Recorders
10 ☐ FM/FM Modulators
15 ☐ Data storage mechanisms

6. Radar, Microwave, UHF Equipment.

67 Antennas.

05 ☐ Feed systems
10 ☐ Receiving
15 ☐ Reflectors
20 ☐ Rotating mechanisms
25 ☐ Transmitting

68 Receivers.

05 ☐ Microwave relay
10 ☐ Position indicators
15 ☐ Radar

69 Transmitters.

05 ☐ Microwave
10 ☐ Microwave relay
15 ☐ Radar

70 Waveguides & Accessories.

05 ☐ Couplings
10 ☐ Delay lines, etc.
15 ☐ Flexible waveguides
20 ☐ Rigid waveguides
25 ☐ Sampling lines, reflectors, etc.
30 ☐ Switches

7. Materials, Fabricating Equipment & Services, Machinery & Tools, Contract Assemblers, Laboratories for Custom Built Equipment, Consulting Engineers.

71 Cable & Wire.

05 ☐ Aluminum
10 ☐ Co-axial cables
15 ☐ Copper, bare
20 ☐ Low-loss, high-frequency types
25 ☐ Precious & rare metals wire
30 ☐ Pre-formed wire harnesses
35 ☐ Rubber insulated
40 ☐ Shielded
45 ☐ Synthetic insulated
50 ☐ Woven wire braid

72 Ceramics.

05 ☐ Coil forms
10 ☐ Custom fabrication
15 ☐ Insulators
20 ☐ Proprietary forms

73 Consulting Engineers.

05 ☐ Acoustical
10 ☐ Electrical
15 ☐ Mechanical
20 ☐ Radio

74 Core Materials.

05 ☐ Laminations
10 ☐ Metallic powders

75 Fabricators & Services.

05 ☐ Contract fabrication & assembly
10 ☐ Electro-plating
15 ☐ Hardening & heat-treating
20 ☐ Hermetic sealing service
25 ☐ Metal stamping & spinning
30 ☐ Plastic fabricators
35 ☐ Plastic moulders

76 Gasses & Vapors.

05 ☐ Acetylene
10 ☐ Argon
15 ☐ Hydrogen
20 ☐ Krypton
25 ☐ Neon
30 ☐ Oxygen
35 ☐ Xenon

77 Hardware, Findings, & Manufacturing Aids.

05 ☐ Adhesive labels & tapes
10 ☐ Bushings & bearings
15 ☐ Cans
20 ☐ Dials & dial assemblies
25 ☐ Flexible shafts
30 ☐ Gaskets
35 ☐ Grommets
40 ☐ Machine screw products
45 ☐ Paper preforms, for coil foundations

50 ☐ Rivets
55 ☐ Screws, nuts & washers
60 ☐ Springs
65 ☐ Terminals, rivet or stud
70 ☐ Terminals, wire end
75 ☐ Terminal boards
80 ☐ Vibration mounts & isolating pads

78 Hermetic Seals.

05 ☐ Complete headers
10 ☐ Ceramic ot metal seals
15 ☐ Glass to metal seals

79 Insulating Materials.

05 ☐ Cambric sheeting
10 ☐ Cambric tubing
15 ☐ Cotton tapes
20 ☐ Fiberglass tapes
25 ☐ Fiberglass tubing
30 ☐ Synthetics

80 Laboratories & Custom Builders.

05 ☐ Individual item builders
10 ☐ Pilot run plants
15 ☐ Research & development labs.
20 ☐ Testing & certifying organizations

81 Lacquers, Paints, Compounds & Waxes.

05 ☐ Coil dope
10 ☐ Conducting paint
15 ☐ Finishing & protecting lacquer
20 ☐ Fungus preventatives
25 ☐ Moisture proofing
30 ☐ Sealing & potting compounds
35 ☐ Silicones

82 Machinery & Tools.

05 ☐ Coil winding machines
10 ☐ General production machinery & tools
15 ☐ Marking & engraving machines
20 ☐ Soldering irons & guns
25 ☐ Vacuum tube machinery
30 ☐ Vacuum pumps
35 ☐ Vibration exciters
40 ☐ Welders & brazers

83 Metals.

05 ☐ Alloys
10 ☐ Copper
15 ☐ Ferrous
20 ☐ Non-ferrous, excluding copper
25 ☐ Powdered
30 ☐ Precious & rare

84 Moulded Products.

05 ☐ Insulators
10 ☐ Knobs & parts
15 ☐ Proprietary mouldings

85 Plastics.

05 ☐ Extrusions
10 ☐ Raw powders
15 ☐ Rods
20 ☐ Sheets
25 ☐ Tubes

86 Solder.

05 ☐ Acid core
10 ☐ Fluxes
15 ☐ Plain
20 ☐ Precious metal
25 ☐ Pre-forms
30 ☐ Rosin core

87 Vacuum Tube Parts.

05 ☐ Anodes
10 ☐ Envelopes, glass
15 ☐ Envelopes, metal
20 ☐ Getters
25 ☐ Grids & grid wire
30 ☐ Guns & gun parts
35 ☐ Pins & prongs
40 ☐ Spacers & insulators
50 ☐ Tube clamps
55 ☐ Tubing-cathode

8. Test & Measuring Equipment, Laboratory Standards & Supplies.

88 Audio Frequency Test Equipment.

05 ☐ Beat frequency oscillators
10 ☐ Distortion & noise analyzers
15 ☐ Intermodulation meters
20 ☐ Output power meters
25 ☐ RC oscillators
30 ☐ Spectrum analyzers
35 ☐ Square wave generators
40 ☐ Voltmeters-audio frequency

89 General Laboratory Equipment & Supplies.

05 ☐ Chemicals
10 ☐ General laboratory equipment
15 ☐ Screen Rooms
20 ☐ RF Shielding materials

90 General Test Equipment.

05 ☐ Bridges, capacitance
10 ☐ Bridges, impedance
15 ☐ Bridges, resistance
20 ☐ Decades, capacitance
25 ☐ Decades, resistance
30 ☐ Multimeters
35 ☐ Ohm & megohm meters
40 ☐ Strain gauges
45 ☐ Stroboscopes
50 ☐ Vacuum tube testers
55 ☐ Vacuum tube voltmeters
60 ☐ Vibration analyzers

91 Graphic Recorders.

05 ☐ Charts & papers
10 ☐ Ink writing
15 ☐ Inkless types
20 ☐ Fixed speed types
25 ☐ Variable speed types

92 Laboratory Standards of Frequency & Time.

05 ☐ Elapsed time measuring equip
10 ☐ Primary standards of frequenc
15 ☐ Primary standards of time
20 ☐ Secondary standards of frequen
25 ☐ Secondary standards of time
30 ☐ Tuning forks

93 Microwave & Radar Test Equipment.

05 ☐ Pulse generators
10 ☐ Slotted lines & measuring accessories
15 ☐ Time delay generators

94 Nuclear.

05 ☐ Dosimeters
10 ☐ Ionization chambers
15 ☐ Survey meters

95 Oscilloscopes—Cathode-Ray.

05 ☐ General purpose
10 ☐ Oscilloscope cameras
15 ☐ Oscillosynchroscopes
20 ☐ Recording oscillographs
25 ☐ Special UHF & Pulse Analysis equipment

96 Radio Frequency Test Equipment.

05 ☐ Field strength meters
10 ☐ Impedance & admittance meter
15 ☐ Marker generators
20 ☐ "Q" Meters
25 ☐ RF power output meters
30 ☐ Multi-vibrators
35 ☐ Signal generators, AM
40 ☐ Signal generators, FM
45 ☐ Signal generators, TV
50 ☐ SWR meters
55 ☐ Sweep generators
60 ☐ Wavemeters

9. Education & Publishing.

97 Education.

05 ☐ Technical instruction—home study
10 ☐ Technical instruction—resident

98 Publishing.

05 ☐ Book publishers
10 ☐ Magazines

10. Distributional Functions for the Industry.

99 Distribution.

05 ☐ Export & Import
10 ☐ Jobbers & Wholesalers
15 ☐ Manufacturers Representatives
20 ☐ Sales & Service
25 ☐ Surplus dealers

LIST ADDITIONAL PRODUCTS BELOW

PROFESSIONAL CARDS

ALFRED W. BARBER LABORATORIES
Specializing in the Communications Field and in Laboratory Equipment
Offices, Laboratory and Model Shop at:
32-44 Francis Lewis Blvd., Flushing, L.I., N.Y.
Telephone: Independence 3-3306

CROSBY LABORATORIES, INC.
MURRAY G. CROSBY & STAFF
RADIO-ELECTRONIC RESEARCH
DEVELOPMENT & MANUFACTURING
COMMUNICATIONS, FM & TV
ROBBINS LANE
HICKSVILLE, NEW YORK
HICKSVILLE 3-3191

ELDICO OF NEW YORK, INC.
Donald J. S. Merten and Engineering Staff
Consultants on Interference Elimination from Transmitters, Induction Heaters, Diathermy, etc.
44-31 Douglaston Parkway, Douglaston, L.I., N.Y.
Bayside 9-8686

Richard B. Schulz
Electro-Search
Radio-Interference Reduction;
Development of
Interference-Free Equipment,
Filters, Shielded Rooms
4337 N. 5th Street, Philadelphia 40, Pa.
GLadstone 5-5353

ELK ELECTRONIC LABORATORIES, INC.
Jack Rosenbaum
Specializing in design and development of Test Equipment for the communications radar and allied fields
333 West 52nd St., New York 19, PL-7-0520

F-R MACHINE WORKS INC.
ELECTRONICS FXR X-RAY DIVISION
DESIGN - DEVELOPMENT - MANUFACTURE
44-14 Astoria Boulevard Long Island City 3, N.Y.
Phone AStoria 8-2800

HARRIS GALLAY
Electronic Consultant
Military Electronics Since 1935
Your inquiries solicited and our experience is at your command.
60 Perry Street Belleville 9, N.J.
Plymouth 9-4237

PAUL GODLEY CO.
Consulting Radio Engineers
P.O. Box J, Upper Montclair, N.J.
Offs & Lab.: Great Notch, N.J.
Phone: Montclair 3-3000
Established 1926

HIGHLAND ENGINEERING CO.
William R. Spittal & Staff
Design, Development and Manufacture of Transformers, Chokes, Etc. for the Electronic, Industrial and Allied Fields
Main & Urban, Westbury, L.I., N.Y.
WE-7-2933

HOGAN LABORATORIES, INC.
John V. L. Hogan, Pres.
APPLIED RESEARCH, DEVELOPMENT, ENGINEERING
Est. 1929. Electronics, Optics, Mechanisms, Facsimile Communication, Digital Computers, Electro-sensitive recording media, Instrumentation.
155 Perry Street, New York 14 CHelsea 2-7855

LEONARD R. KAHN
Consultant in Communications and Electronics
Single-Sideband and Frequency-Shift Systems
Diversity Reception - Modulation Theory
Applications of Magnetic Tape Recording
Elizabeth Bldg., 22 Pine St., Freeport, L.I., N.Y.
Freeport 9-8800

DAVID C. KALBFELL, Ph.D.
KAY-LAB Electronic Instruments
Laboratory and Manufacturing Facilities
Specializing in Electronic
Instrumental and Industrial Problems
1090 Morena Blvd. - Woodcrest 6359
San Diego 10, California

HARRY R. LUBCKE
CONSULTING TELEVISION ENGINEER
Television Engineering Since 1929
Electronics
2443 CRESTON WAY HO. 9-3266
HOLLYWOOD 28, CALIFORNIA

MEASUREMENTS CORP.
RESEARCH & MANUFACTURING ENGINEERS
Harry W. Houck Jerry B. Minter
John M. van Beuren
Specialists in the Design and Development of Electronic Test Instruments
BOONTON, N.J.

L. J. CASTRIOTA M. WIND
S. W. ROSENTHAL P. G. MARIOTTI
Microwave Consultants
Radio Frequency and Microwave Components
Telephone G.P.O. Box 844
BOulevard 3-2096 Brooklyn 1, N.Y.

MICROWAVE SERVICES, INC.
"Architects of Modern Communications"
CONSULTANTS, ENGINEERS, CONSTRUCTORS
Wire, Carrier, Radio—Inside and Outside Plant Facilities
S. K. Wolf, E. Labin, V. J. Nexon, and Associates
45 Rockefeller Plaza, New York 20 Circle 7-4953

A. NEWTON
Circuit analysis, design and development in the fields of VHF, UHF tuners, TV receivers and accessories, laboratory and test instrumentation.
105-20 66th Ave., Forest Hills, N.Y.
TW 7-9429

PICKARD AND BURNS, INC.
Consulting Electronic Engineers
Analysis and Evaluation of Radio Systems
Research, Development, Design and Production of Special Electronic Equipment and Antennas.
240 Highland Ave. Needham 94, Mass.

PSC APPLIED RESEARCH LTD.
Development & Production
AIRCRAFT and INDUSTRIAL
INSTRUMENTS ● AIDS ● SYSTEMS
Navigation - Survey - Processing - Servo
Gyro - Photo - Magnetic - Electronic
Radiation - Optical
J. M. Bridgman, General Manager
1450 O'Connor Drive Toronto, Canada

PAUL ROSENBERG ASSOCIATES
Consulting Physicists
100 STEVENS AVE. • MOUNT VERNON, NEW YORK
CABLE: PHYSICIST MOunt vernon 7-8040

TELECHROME, INC.
Electronic Design Specialists
COLOR TELEVISION EQUIPMENT
Flying Spot Scanners, Color Synthesizers, Keyers, Monitors, Oscilloscopes and Related Apparatus
J. R. Popkin-Clurman, Pres. & Ch. Engr.
88 Merrick Rd. Amityville, L.I., N.Y.

TELREX, INC.
M. D. Ercolino, Pres.
H. F. ANTENNA SPECIALISTS
Communication Arrays
Reception or Transmission
For FM, TV, and Amateur Service.
Asbury Park, N.J.—Phone AP 2-7252

WHEELER LABORATORIES, INC.
Radio and Electronics
Consulting — Research — Development
R-F Circuits — Lines — Antennas
Microwave Components—Test Equipment
Harold A. Wheeler and Engineering Staff
Great Neck, N.Y. Great Neck 2-7806

WIHTOL LABORATORIES
Consulting — Research — Development — Electron Tubes — Vacuum and Gas Tube Manufacturing Techniques — Glass Techniques — Special Purpose Tubes.
W. Wihtol, Director
2333 Grey, Evanston, Illinois
University 4-7896

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 159A)

Catalog on Mobile Equipment

A comprehensive "summary" catalog has just been completed by the **Kaar Engineering Corp.**, Middlefield Road, Palo Alto, Calif., covering all their mobile products.

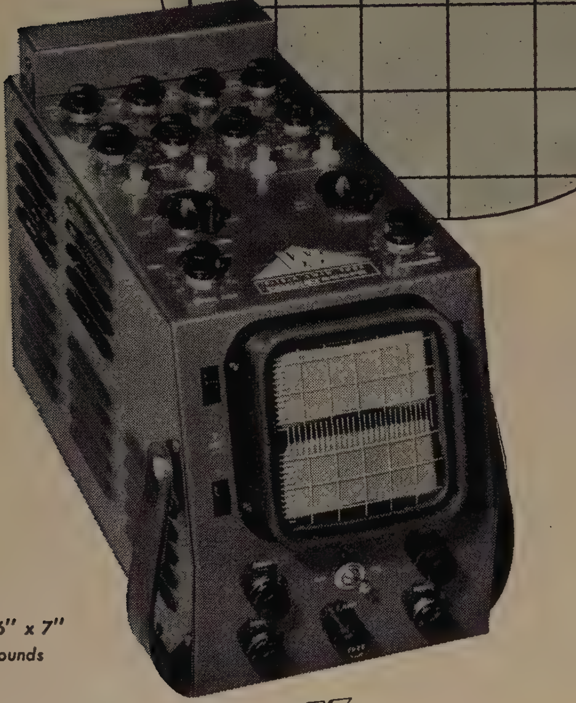
Information is presented in capsule form to give a quick reference to anyone using radiotelephone equipment.

Kaar manufactures mobile equipment and station equipment for use in the 152–174 mc band, the 25–50 mc band, and the 1,600–6,000 kc band. In addition, the complete line of Kaar accessories is included in the catalog.

Copies are available by writing the manufacturer.

(Continued on page 166A)

the Waterman TWIN POCKETSCOPE®



MODEL S-15-A

Size:
12" x 6" x 7"
16¼ Pounds

ANOTHER EXAMPLE OF Waterman PIONEERING...

The WATERMAN TWIN POCKETSCOPE, model S-15-A, presents a new concept in multiple trace oscilloscopy with independent vertical channels each having a sensitivity of 10 millivolts rms/inch, and a response within —2 db from DC to 200 KC—a pulse rise time of 3 microseconds. These features combined with the provisions for intensity modulating either, or both, traces, results in greater flexibility. The sweep generator is operated either in the repetitive or triggered mode from 0.5 cycles to 50 KC with synchronization polarity optional. All attenuators and gain controls are of the non-frequency discriminating type. Remember that portability has not been overlooked! The amazing small size of the S-15-A tips the scales of opinion heavily in its favor. Imagine, all of these essential characteristics in an instrument weighing only 16¼ lbs. You can carry it to any job, anywhere!

WATERMAN PRODUCTS CO., INC.
PHILADELPHIA 25, PA.
CABLE ADDRESS: POKETSCOPE

MEMO... Write for details today!

WATERMAN PRODUCTS INCLUDE

S-4-A SAR PULSESCOPE®
S-5-A LAB PULSESCOPE
S-11-A INDUSTRIAL POCKETSCOPE
S-12-B JANized RAKSCOPE®
S-14-A HIGH GAIN POCKETSCOPE
S-14-B WIDE BAND POCKETSCOPE

Also RAYONIC® Cathode Ray Tubes and Other Associated Equipment

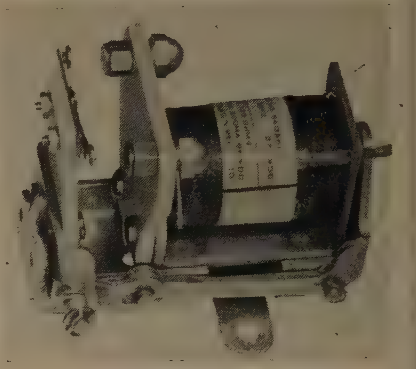
WATERMAN PRODUCTS

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 165A)

High Voltage Relay

A compact, lightweight relay (Series 2800), built to military requirements for applications in all types of ground and airborne equipment, has been developed by **Advance Electric and Relay Co.,** 2435 N. Naomi St., Burbank, Calif.



This relay is of the single-throw normally-open double-make type. It may be had also as SP-ST normally-closed and SP-DT. It will operate with any coil over a range of 1.5 to 250 volts dc, 27.5 volts dc nominal, and will withstand 1000 volts rms between coil and ground. The contacts are D54 alloy, 3/16 inch diameter movable, 1/40 inch diameter stationary, and are capable of carrying 0.25 amperes at 8,000 volts dc. They will withstand 8,000 volts dc between stationary contacts and ground and 3,250 volts rms between contacts and ground. Insulation is ceramic steatite, and the relay is mounted on two center inserts for studs. They may be had with or without side mounts. The overall dimensions are: Length, 2⅛ inches; Height, 1⅞ inches; Width, 1⅝ inches.

Dosimeter Charger

A new Dosimeter Charger (Model 561), designed to charge all makes of direct-reading pocket dosimeters to any voltage from 110 to 225 volts, is now available from **Victoreen Instrument Co.,** 3800 Perkins Ave., Cleveland 14, Ohio.

The internally lighted charging socket extends ½ inch above the case top to re-

(Continued on page 168A)

History Making Issues

The secret ingredient in the amazing progress of radio-electronics is the speedy exchange of ideas through engineering publications. Radio scientists have made history by this idea-sharing method of advancement, through publishing.

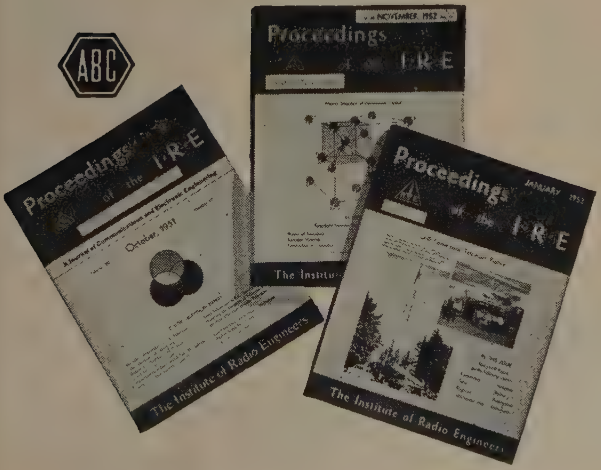
Three Great Issues

Examples of this kind of publishing are the now historic issues of "Proceedings of the I.R.E." on "Color Television," October 1951; and "Transistors," November 1952; and "Ultra High Frequencies," January 1953. Each of these issues provided the practical and the research engineer with an "ahead-of-its-times" text book on those electronic developments which set the pattern for radio manufacturing for the next decade. Only a reliable engineering society journal could do this kind of publishing job.

Coming Issue on Computers

Radio has developed in three stages: First came audible communication, the wireless "dot and dash," now perfected to the beauty of high-fidelity sound. Next came sight in images on the cathode-ray tube, with the glories of color already in development. Sound, sight, and now "thinking" achieved through radio controls and the electronic computer. In October 1953, "Proceedings of the I.R.E." devotes another of its history making issues to the Electronic Computer.

A publishing supremacy, all its own, has been won by "Proceedings of the I.R.E." Often considered second in its field by the measures of circulation and advertising volume, it holds a place never surpassed either in volume or vital value of its editorial content. The result has logically been a high quality reader—the thinking engineer, whose approval you must win. To sell the radio industry, tell the radio engineer!



"Proceedings of the I·R·E"

Published by the

INSTITUTE OF RADIO ENGINEERS

Advertising Department

1475 Broadway, New York 36, N. Y.
BRyant 9-7550

MICROWAVE RESISTORS
TELEWAVE TYPE R

SMALLEST RESISTOR AVAILABLE
(Ideal for Miniaturization)

3/16"

TYPICAL APPLICATIONS
- Power measurement at any frequency
- Matched terminations for waveguides or coaxial lines
- Resistive power pickup loops
- RF pads or attenuators
- Dummy loads
- Temperature measurements
- Impedance matching

TYPE R RESISTORS employ noble metal film deposits on specially selected heat resistant glass.
FILM THICKNESS offers negligible skin effect, at microwave frequencies.
POWER CAPACITY of 1/4 watt provides high power handling ability.
PHYSICAL STRUCTURE is ideally suited to impedance matching in standard coaxial line and waveguides.
FINISH. Coated with a special silicone varnish to protect the film.

SPECIFICATIONS
Resistance: 50 ohms standard, other values on request.
Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 25°C
Size: 1/16 inch diam. x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 — 1/16 inch
Type R-093 — 3/32 inch
Temperature Coefficient: approx. 0.0019 ohms/ohm/°C.
Power Sensitivity: Approx. 10 ohms/watt

AVAILABLE FOR IMMEDIATE DELIVERY

TELEWAVE LABORATORIES, INC.
100 Metropolitan Ave. • Brooklyn 11, New York

CLOSE-TOLERANCE CONSTRUCTION PLUS... QUALITY CONTROL... brings you the best in paper tubes

PRECISION
PAPER TUBES

Made of the finest dielectric kraft, fish paper, acetate, or combinations, PRECISION Paper Tubes are die-formed under heat and pressure. Uniformity, strength, and light weight are assured. High manufacturing standards and rigid testing result in maximum insulation, heat dissipation, and moisture resistant characteristics.

Available in any shape, length, I.D. or O.D. Finished to your exact specifications.

SEND TODAY FOR FREE SAMPLE AND REQUEST NEW ARBOR LIST OF OVER 1500 SIZES.

PRECISION PAPER TUBE CO.
2051 W. CHARLESTON ST. CHICAGO 47, ILL.
Plant No. Two, 79 Chapel St., Hartford, Conn.
Also Mfrs. of Precision Coil Bobbins

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 166A)

ceive dosimeters of larger outside diameters than the standard Victoreen Models 541/A, 547/A, 548 and 534/A.

The charger features a single off-on-charge knob and a spring loaded charger socket to prevent damage to the dosimeter due to excessive pressure by the operator. Waterproof, the entire unit is 4×5×6 inches and weighs three pounds. Power supply is ten, 22½ volt and one, 1½ volt batteries.

Decade Amplifier

Hermon Hosmer Scott, Inc., 385 Putnam Ave., Cambridge 39, Mass., has developed a new Decade Amplifier (Type 140A) which is a miniaturized laboratory-voltage amplifier with 1 mc frequency response and stabilized voltage gains of 10 and 100. Typical applications are to extend sensitivities of oscilloscopes, vacuum-tube voltmeters, and other indicating or recording devices. A low-flux-density transformer permits the amplifier to be used without affecting nearby equipment operating at low signal levels. The amplifier is entirely resistance coupled, and no peaking coils or compensating networks are used which might cause undesirable transient effects.

Frequency response is flat from 2 cps to 1 mc, 0.1 db. Equivalent input noise is less than 8 microvolts in the ×100 position. Maximum undistorted output voltage is 40 volts. Maximum output current is 1 milliampere. Phase shift and distortion are entirely negligible. The unit is completely self-contained with a built-in 117 volt ac power supply. Line voltage variations between 70 and 130 volts cause less than 0.1 db changes in output. Binding posts are plug-in type. Input impedance, 1 megohm shunted by 10 μμf. An accessory high-impedance vacuum-tube probe is available for use where even slight loading of sensitive circuits is to be avoided. Free bulletin on request.

(Continued on page 170A)

ZOPHAR
---WAXES
---COMPOUNDS

Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types; radio, television, etc. Cold flows from 100°F. to 285°F. Special waxes noncracking at —76°F. Compounds meeting Government specifications plain or fungus resistant. Let us help you with your engineering problems.

107 YEARS

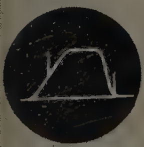
ZOPHAR MILLS, INC.
112-130 26th Street,
Brooklyn 32, N. Y.

NEED INSTRUMENTS TO SOLVE ELECTRONIC PROBLEMS?...

RADA-SWEEP
Radar IF Amplifier Alignment

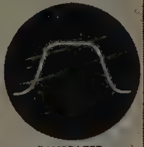
MEGA-MATCH
Measurement of Reflection Coefficient

MEGA-PULSER
Transient Testing Video Amplifiers



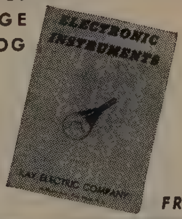
MARKA-SWEEP RF-P
TV Tuner Alignment

RADA-PULSER
Radar IF Transient Testing



CALIBRATED MEGA-SWEEP
Wide Range Sweeping Oscillator
Single Dial Tuned

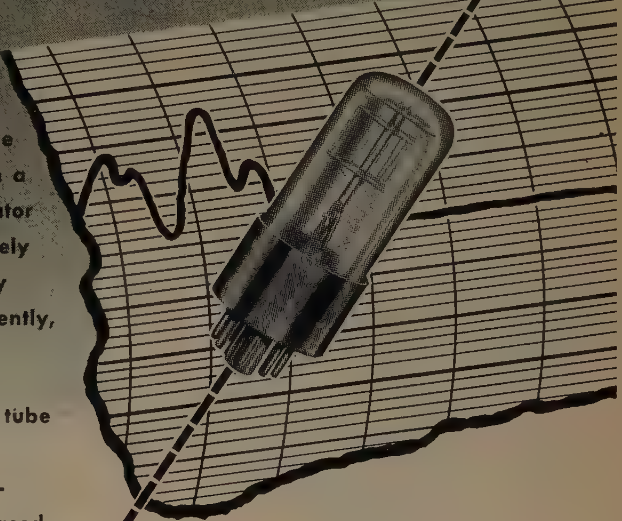
CONSULT THIS LATEST 64-PAGE CATALOG



Write FREE

KAY ELECTRIC CO.
4 MAPLE AVE. PINE BROOK, N. J.

KEEP CURRENT CONSTANT WITH VICTOREEN CURRENT REGULATOR TUBES



Replace that expensive regulating circuit with a single current regulator tube designed to closely regulate line or battery current—simply, efficiently, at minimum cost.

In a current regulator tube an increase in current is automatically compensated for by increased resistance.

What About...

CURRENT RANGE . . . Many tube types available .025 to 6 amps. A.C. & D.C.
VOLTAGE DROP . . . . Varies 1 to 100 V depending on current, bulb size.
PHYSICAL SIZE . . . . . Standard T-6, T-9 or ST-14 —octal or miniature base.
ENVIRONMENTAL CONDITIONS . . . . . Reliable operation at extreme temperatures, humidity, altitude.
MIL SPECS . . . Type approved tubes available.

ELECTRICAL CHARACTERISTICS . . . TYPICAL TYPES

Type No.	Voltage (V)	Currents (Amps)
CR80–20	20–60	.080
CR140–20	20–35	.140
CR200–20	20–40	.200
CR350–5	5–12	.350
CR600–4	4–10	.600
CR800–4	4–10	.800
CR900–4	4–11	.900
CRM900–5	5–9	.900
CR950–4	4–11	.950
CR1635–5	5–9	1.635
CR1700–2	2–4	1.700
CRM1700–2	2–4	1.700
CR3500–3	3–6	3.500
CR4200–3	3–6	4.200

Write for further details—include specifications for your application

BETTER COMPONENTS MAKE BETTER INSTRUMENTS

The Victoreen Instrument Co.
3800 PERKINS AVENUE • CLEVELAND 14, OHIO

AIR-SPACED ARTICULATED

CO-AX

CABLES

offer a unique combination of

- ✓ FRACTIONAL CAPACITANCE
- ✓ HIGH IMPEDANCE
- ✓ MINIMUM ATTENUATION

ALONG WITH

- ✓ EXCEPTIONAL FLEXIBILITY
- ✓ LIGHT WEIGHT

38 STOCK TYPES

FOR ANY OF YOUR STANDARD OR SPECIAL APPLICATIONS

A few of the very low capacitance types are:

Type No.	*Capacitance* $\mu\mu F/ft.$	*Impedance ohms*	*O.D.*
C.44	4.1	252	1.03″
C.4	4.6	229	1.03″
C.33	4.8	220	0.64″
C.3	5.4	197	0.64″
C.22	5.5	184	0.44″
C.2	6.3	171	0.44″
C.11	6.3	173	0.36″
C.1	7.3	150	0.36″

WE ARE SPECIALLY ORGANIZED TO HANDLE DIRECT ORDERS OR ENQUIRIES FROM OVERSEAS

SPOT DELIVERIES FOR U.S.

BILLED IN DOLLARS—SETTLEMENT BY YOUR CHECK

CABLE OR AIRMAIL TODAY

TRANSRADIO LTD.

CONTRACTORS TO H.M. GOVERNMENT

138A CROMWELL RD., LONDON, S.W.7
ENGLAND

CABLES: TRANSRAD LONDON

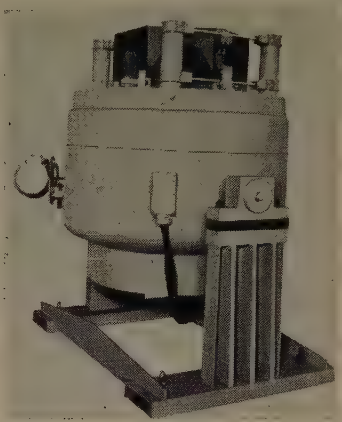
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 168A)

Vibration Exciter

What is said to be the largest general purpose vibration generator ever built has been announced by the **MB Manufacturing Co.,** 1060 State St., New Haven 11, Conn. This shaker is of the electromagnetic type, and rated by the manufacturer at 10,000 pounds force output. Supplied with conservatively rated rotating power supply and equipped with forced-air cooling, the shaker is claimed to have the capacity for continuous duty at this output.



According to the specifications for this

(Continued on page 171A)

Direct Coupled
Wide Band Amplifier

A unique instrument to amplify small DC and high frequency potentials found in research in such fields as physiology, geophysics, strain measurements and analog computing.

Response Frequency response, flat ±2% to 20,000 cps, is usable to at least 100 kc.

Gain Differential voltage gain of 100,000 stabilized by negative feed back to ±1%.

Noise Less than 10 microvolts of noise at widest bandwidth with input shorted.

Drift Drift is less than 5 microvolts per minute with the AEL 351 Power Supply.

Input Input impedance is 100 meg. with less than 0.1 microamp. grid current.

Output Low output impedance directly drives oscillographs, recording instruments.

Write for detailed specifications and catalog.

American Electronic Laboratories
INCORPORATED
641 Arch Street, Philadelphia 6, Pa.

SEE IRE DIRECTORY QUESTIONNAIRE

Pages 161A, 162A, 163A & 164A

30,000 Engineer Members will receive and use this book.

Be Sure Your Firm Is Listed!

Need Precision MINIATURE Potentiometers?

NOW—more than ever

The leader in the multi-turn miniature potentiometer field
THE NEW IMPROVED FORD SERIES "B" MULTIPOT 10 TURNS: 1″ body length; 1″ diameter

MAJOR DESIGN IMPROVEMENTS ACCOMPLISHED IN 1953
result in an
EXCEPTIONALLY HIGH DEGREE OF RELIABILITY
(All units unconditionally guaranteed for 1 year)

Also available in 5-turn units and in dual ganged units. We can supply 1″ dia. high-precision 10-turn dials to fit our pots.

Check these features:

RESISTANCE TOLERANCES TO ±1%
LINEARITY ACCURACIES TO ±.05%
END RESISTANCES UNDER 0.1%
RESISTANCES UP TO 100,000 ohms
UNSURPASSED DEPENDABILITY

Write for Catalog #8 with prices and descriptions of our other potentiometers.

FORD ENGINEERING COMPANY
129 East "A" Street, Upland, California

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 170A)

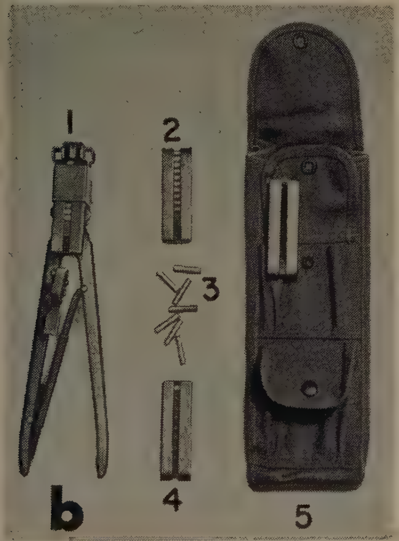
Model C-100 Exciter, the shaker table is supported on specially designed forged steel flexures to help insure straight line motion with no resonances in the equipment's operating range of 5 to 500 cps. The manufacturer states flexure stiffness permits placing heavy loads on table without sacrificing a large portion of the available stroke of $\frac{1}{2}$ inch.

Trunnion supports have built-in vibration isolators and permit operation in any position from horizontal to vertical.

The control panel has completely interlocking controls to prevent mis-starting or mis-operation. Controls are provided for force and frequency; also various selector switches for the three alternators supplying the exciter's driver coil. For details write to E. G. Oravec.

Wire Splicer

A new tool for rapidly splicing communication wire has been developed under Signal Corps sponsorship by **Aircraft-Marine Products, Inc.,** Harrisburg, Pa. This semi-automatic splicer is expected to eliminate to a great extent the slow hand-splicing method which has been used for many years by Army wiremen.



Signal Corps Photo

With the new tool and its splicing sleeves, waterproof splices of high tensile strength can be made in less than 30 seconds without the use of tapes or other tools. A man wearing heavy mittens can easily make splices under the most unfavorable conditions.

The wires to be joined are stripped with a stripper attached to the tool handle. A tubular connector sleeve is forced into the jaws of the tool from the magazine in which it has been carried. The ends of stripped wire are inserted into the connector sleeve, and the tool handles are squeezed together, completing the splice. A ratchet device makes opening of the crimping jaws impossible until enough pressure has been applied to insure a neat, strong waterproof and perfect splice.

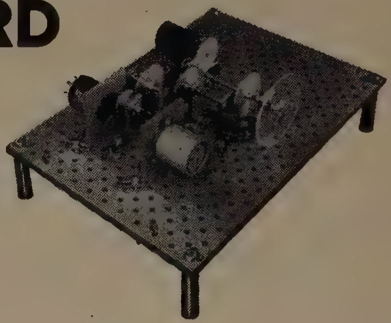
(Continued on page 172A)

SERVOSCOPE®

Test analyzer for use in development and PRODUCTION of SERVOMECHANISMS and PROCESS CONTROLS. Measures FREQUENCY RESPONSE, PHASE SHIFT 0.1 to 20 CYCLES SINE WAVE, SQUARE WAVE, MODULATED CARRIER, 50 to 800 CYCLES.

SERVOBOARD

A FLEXIBLE SET of PRECISION mechanical parts for quickly coupling motors, synchros, potentiometers to form assemblies of Servo systems, regulators, computors.



SERVO CORPORATION OF AMERICA

IRE-5

NEW HYDE PARK, N.Y.

IT'S

HARVEY

FOR PROMPT

"OFF-THE-SHELF" DELIVERY

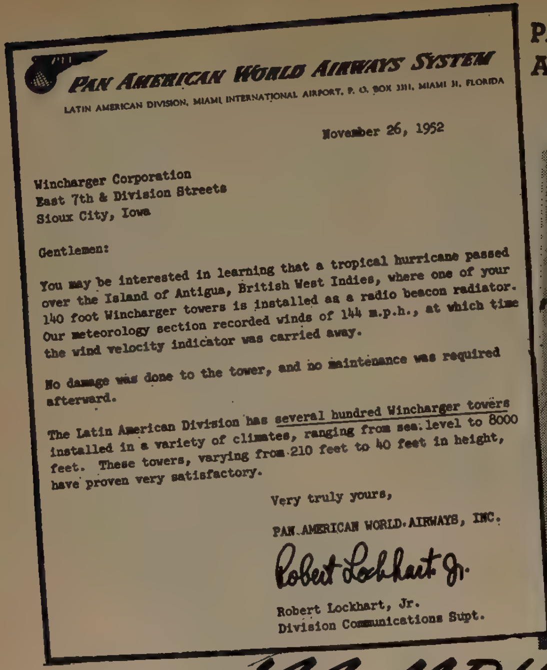
Whether it's equipment, components or other electronic requirements, you will always find them in Harvey's extensive stocks, ready for immediate delivery to you anywhere.

Harvey's twenty-five years of service to the industry are your assurance of understanding 'know-how' and complete dependability.

WRITE
PHONE
or WIRE

HARVEY
RADIO COMPANY, INC.
103 West 43rd St., New York 36, N. Y.

Telephone
LUxemberg 2-1500



PAN AMERICAN WORLD AIRWAYS SYSTEM
LATIN AMERICAN DIVISION, MIAMI INTERNATIONAL AIRPORT, P. O. BOX 3311, MIAMI 31, FLORIDA

November 26, 1952

Wincharger Corporation
East 7th & Division Streets
Sioux City, Iowa

Gentlemen:

You may be interested in learning that a tropical hurricane passed over the Island of Antigua, British West Indies, where one of your 140 foot Wincharger towers is installed as a radio beacon radiator. Our meteorology section recorded winds of 144 m.p.h., at which time the wind velocity indicator was carried away.

No damage was done to the tower, and no maintenance was required afterward.

The Latin American Division has several hundred Wincharger towers installed in a variety of climates, ranging from sea level to 8000 feet. These towers, varying from 210 feet to 40 feet in height, have proven very satisfactory.

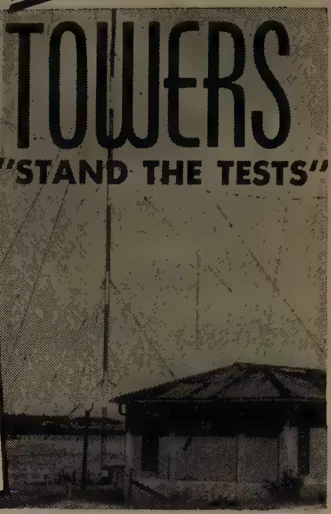
Very truly yours,

PAN AMERICAN WORLD AIRWAYS, INC.

Robert Lockhart Jr.

Robert Lockhart, Jr.
Division Communications Supt.

PAN-AMERICAN WORLD AIRWAYS PROVE THAT WINCHARGER



even in 144 M.P.H. hurricanes!

Wincharger Towers are specified throughout the world because of their unusual strength, low initial and maintenance costs, and engineered efficiency for TV, AM-FM, or 2-way Communication Systems. Wincharger engineers know how to combine low cost, high safety factors, and efficient radiation. Let us solve your tower problems.
Write —Wire—Phone 2-1844.

WINCHARGER CORPORATION 2108 E. 7th St.
Sioux City, Iowa

FREE 236-PAGE
ALLIED 1953
ELECTRONIC SUPPLY CATALOG

World's Largest Stocks of Electronic Supplies for Industry and Broadcast Stations

ONE COMPLETE DEPENDABLE SOURCE FOR EVERYTHING IN ELECTRONICS

Simplify and speed your purchasing of electronic supplies and equipment—send *all* your orders to ALLIED—the reliable one-supply-source for *all* your electronic needs. Depend on ALLIED for the world's largest stocks of special-purpose electron tubes, test instruments, audio equipment, electronic parts (transformers, capacitors, controls, etc.) and accessories—complete lines of quality apparatus. Our expert Industrial supply service saves you time, effort and money. Send today for your FREE copy of the 1953 ALLIED Catalog—the *complete, up-to-date* guide to the world's largest stocks of Electronic Supplies for Industrial and Broadcast use.

We specialize in Electronic Equipment for Research, Development, Maintenance and Production Operation

SEND FOR FREE 1953 CATALOG

ALLIED RADIO CORP.

833 W. Jackson Blvd.
Dept. 35-E-3
Chicago 7, Illinois

News—New Products

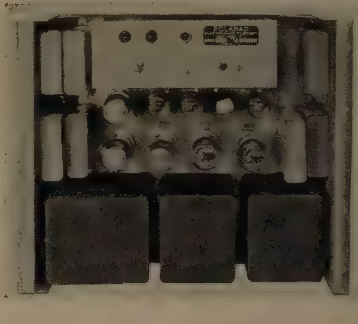
These manufacturers have invited PROCEEDINGS readers to write for literature and further technica information. Please mention your I.R.E. affiliation

(Continued from page 171A)

DC Power Supply

Polarad Electronics Corp., 100 Metropolitan Ave., Brooklyn 11, N. Y., announces a new addition to its series of regulated dc power units.

The output voltage is precisely regulated and adjustable from 400 to 450 volts at load currents of 225 ma to 325 milliamperes. The regulation of the Model PT-110 is better than 0.2 per cent and has a ripple of less than 8 millivolts, RMS. Centering current return is available for television application. A bias supply, negative 150 volts, 10 ma, is also contained in the unit. This unit will operate over a range of 105–125 volts, 50–400 cps.



The power supply is of dishpan type construction and rack mounting chassis. Oil filled capacitors are used throughout. A control panel mounted in front of the unit contains a power switch, pilot light, fuses, test jacks, and voltage control adjustment.

Germanium Rectifier

The **General Electric Co.**, Syracuse, N. Y. has a new germanium rectifying device, hermetically sealed and used to operate a dc motor direct from an ac power line. It is smaller and more efficient than other rectifiers with similar ratings.

The new rectifier can easily be incorporated into industrial variable-speed motor drives. Among possible applications are motor drives for drill presses, engine lathes, centrifuges, and looms.

The new device is about one-fourth the size of other rectifiers with similar ratings. It is more than 98 per cent efficient, according to G.E., and is capable of handling sufficient power to operate a one-half horsepower dc motor, yet is small enough to permit installation directly on the motor.

The company will produce these rectifying devices to fit the requirements of specific applications. Ultimately, a line of units with standardized ratings will be produced. Use of the new rectifier will make possible more flexible factory layout. Machines may be located at the most convenient point, without special power distribution or bulky rectifying considerations.

BUTTON CERAMIC CAPACITORS

for VHF & UHF circuits

Unique design possibilities . . . better VHF and UHF performance . . . simplified equipment construction—these are but a few of the advantages of Sprague Button Ceramic Capacitors. In coupling, bypass, and feed-thru filter applications, these wafer-dielectric units have higher self-resonant frequencies than capacitors using a conventional dielectric tube.

Button stand-off types, for example, minimize ground inductance and hold it at a fixed value while providing a short and radially uniform bypass to ground. The dielectric button is housed in the top of a hex head machine screw, or in a metal shell for ferrule clip mounting. Lug terminals are located at tube socket height for short, uniform lead lengths.

All Sprague button capacitors are sealed against moisture by a high temperature plastic resin . . . are rated at 500 volts dc . . . and are available in Characteristic SL and GA bodies. A letterhead request for Engineering Bulletin 605 brings complete details. Write Sprague Electric Company, 235 Marshall Street, North Adams, Massachusetts.

SPRAGUE

WORLD'S LARGEST CAPACITOR MANUFACTURER

EXPORT FOR THE AMERICAS: SPRAGUE ELECTRIC INTERNATIONAL LTD., NORTH ADAMS, MASS. CABLE: SPREXINT

Proceedings of the I.R.E. June, 1953, Vol. 41, No. 6. Published monthly by the Institute of Radio Engineers, Inc., at 1 East 79 Street, New York 21, N.Y. Price per copy: members of the Institute of Radio Engineers $1.00; non-members $2.25. Yearly subscription price: to members $9.00; to non-members in United States, Canada and U.S. Possessions $18.00; to non-members in foreign countries $19.00. Entered as second class matter, October 26, 1927, at the post office at Menasha, Wisconsin, under the act of March 3, 1879. Acceptance for mailing at a special rate of postage is provided for in the act of February 28, 1925, embodied in Paragraph 4, Section 412, P. L. and R., authorized October 26, 1927.

Table of Contents will be found following page 64A

NOW! Signaling and Control Units
for Single Direction Service!
DTU-1
DRU-1

Hammarlund Separate Transmitters and Receivers Offer Maximum Design Flexibility!

Two independent operations for signaling, dialing, slow speed telemetering, or supervisory control may be transmitted in one direction by one Dual Transmitter Unit (DTU-1) and one Dual Receiver Unit (DRU-1) now available.

These units were engineered for operation over wire lines, telephone or power line carrier and radio or microwave communications circuits, and incorporate the same proven basic features as the Hammarlund Duplex Signaling Unit, except that operations may be carried on in one direction only. Each unit includes its own power supply.

The DTU-1 incorporates a pair of transmitters consisting of a stable tone generator and an amplifier designed to bridge across a 600-ohm circuit, all mounted on a 3½ inch standard relay rack panel. Harmonic distortion is negligible, frequency stability is excellent and a total of 36 frequency channels are available between 2000 and 6475 cycles.

The DRU-1 incorporates a pair of receivers consisting of two stages of amplification, a signal rectifier, relay tube and relay, and a sharply selective band pass filter unit, all mounted on a 5¼ inch standard relay rack panel.

Either a continuous or a keyed tone may be used. The units may be installed in multiple and with Hammarlund 2-way signaling units (DSU-2's) as individual installations require.

Write for Bulletin 115 for detailed information.

HAMMARLUND

HAMMARLUND MANUFACTURING CO., INC.
460 WEST 34th ST. • NEW YORK 1, N. Y.

Meetings with Exhibits

• As a service both to Members and the industry, we will endeavor to record in this column each month those meetings of IRE, its sections and professional groups which include exhibits.

△

August 19, 20, 21, 1953

1953 Western Electronics Show and Convention, Civic Auditorium, San Francisco, Calif.

Exhibits: Heckert Parker, 1355 Market St., San Francisco 3, Calif.

△

September 21, 22, 23, 24 & 25, 1953

Eighth National Instrument Conference and Exhibit. Hotel Sherman, Chicago, Ill.

Exhibits: Richard Rimbach, 921 Ridge Ave., Pittsburgh 12, Pa.

△

September 28, 29 & 30, 1953

National Electronic Conference Hotel Sherman, Chicago.

Exhibits: Orville Thompson, c/o DeForrest's Training Inc., 2735 N. Ashland Ave., Chicago 14, Ill.

△

February 4, 5 & 6, 1954

Sixth Southwestern I.R.E. Conference & Electronics Show, Tulsa, Oklahoma

△

March 22, 23, 24 & 25, 1954

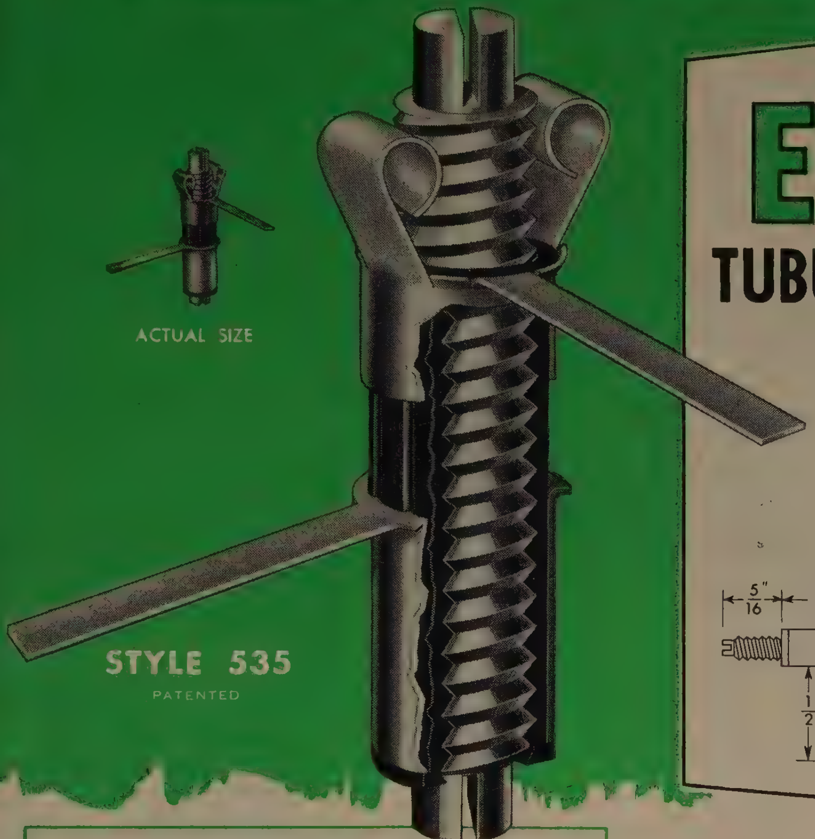
Radio Engineering Show and I.R.E. National Convention, New York City. Exhibits at Kingsbridge Armory and headquarters hotel Waldorf Astoria. Direct connections by subway and by private express busses.

Exhibits Manager: Wm. C. Copp, 1475 Broadway, New York 36, N.Y.

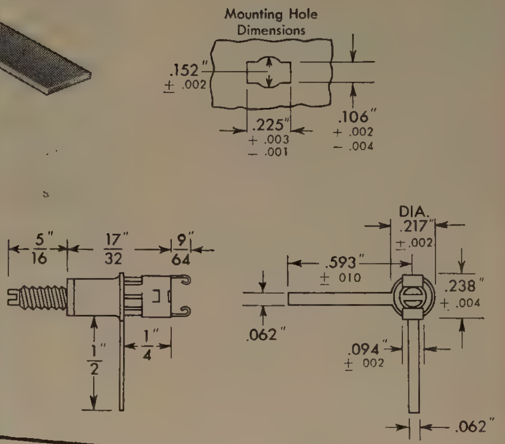
△

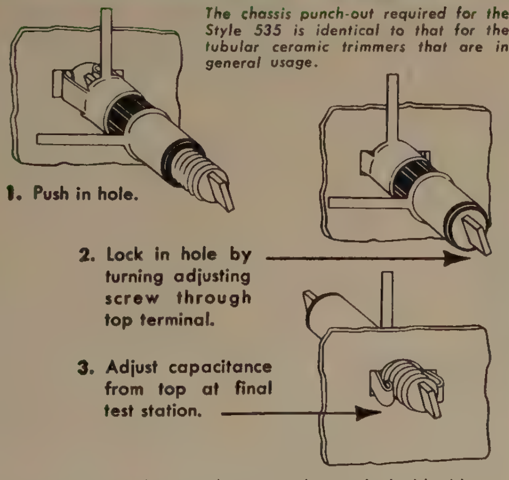
Note on Professional Group Meetings: Some of the Professional Groups conduct meetings at which there are exhibits. Working committeemen on these groups are asked to send advance data to this column for publicity information. You may address these notices to the Advertising Department, and of course listings are free to IRE Professional Groups. All members are invited to read pages 110A and 111A in this issue for more information about IRE's 21 Professional Groups.

REAL Miniaturization... PLUS Low Loss for UHF...



ERIE STYLE 535 TUBULAR TRIMMER




1. Push in hole.
2. Lock in hole by turning adjusting screw through top terminal.
3. Adjust capacitance from top at final test station.

The chassis punch-out required for the Style 535 is identical to that for the tubular ceramic trimmers that are in general usage.

The capacitance adjusting plunger can be supplied with either screw driver slot shown in the large illustration, or with a milled flat end illustrated above.

Simplicity of design makes possible the extremely small size of the ERIE Style 535 Trimmer. The same simplicity of design results in very low inductance and unifrom, straight-line, noiseless adjustment. It can be mounted close to associated circuit elements, and the ribbon type leads help to minimize inductance in UHF circuits.

When mounted, the high temperature, polystyrene body, extends only 17/32" from the underside of the chassis, and is only 7/32" in diameter. As shown at the left, the operator works from only one side of the chassis when installing the trimmer . . . a production cost saving feature . . . no additional hardware required.

The ERIE Style 535 Tubular Trimmer combines the desirable features of small size, easy mounting, stable performance and economical price. Capacity range is from 0.7 to 3.0 mmf and working voltage is 500 volts. Write for full information and samples.

ERIE components are stocked at leading electronic distributors everywhere.

25th Anniversary
TRADE ERIE MARK
RESISTOR CORP.

ERIE RESISTOR CORPORATION . . . ELECTRONICS DIVISION

Main Offices: **ERIE, PA.**

Sales Offices: Cliffside, N. J. • Philadelphia, Pa. • Buffalo, N. Y. • Chicago, Ill.
Detroit, Mich. • Cincinnati, Ohio • Los Angeles, Calif.

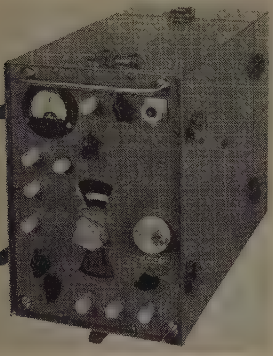
Factories: **ERIE, PA. • LONDON, ENGLAND • TORONTO, CANADA**

NEWS and NEW PRODUCTS

June 1953

Noise Meter

Empire Devices, Inc., 38-25 Bell Blvd., Bayside, N. Y., is producing a noise meter, Model NF-114, commercial equivalent of AN/PRM-14.



It has a frequency range of 0.15 mc to 80 mc in 8 bands, and the frequency ranges are switched by means of a turret.

Two tuned rf amplifier stages are employed throughout for high sensitivity and optimum rejection of spurious responses. Three IF frequencies are used, namely 0.125, 0.455, and 6 mc.

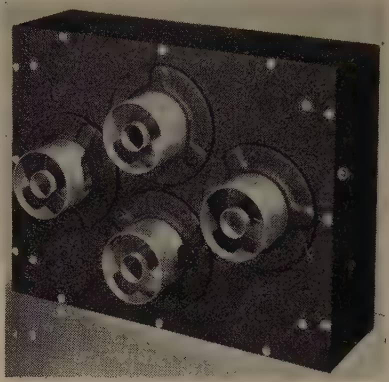
A built-in impulse generator produces flat output to 100 mc. Vacuum tube voltmeter indicates carrier or true peak voltage. As an alternate means of measurement, aural slide-back operation is provided.

Model NF-114 will operate on dry batteries or ac (regulated "A" and "B").

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

Coaxial Switch

Thompson Products, Inc., Electronics Div., 2196 Clarkwood Rd., Cleveland 3, Ohio, has developed a manually actuated



switch for $3\frac{1}{8}$ inch, rigid line television station application. At frequencies to 320 mc, the switch has a maximum VSWR of 1.1 and crosstalk in excess of 60 db. Its characteristic impedance is 51.5 ohms. It weighs approximately 27 pounds and has a minimum life of 100,000 actuations. Technical data available upon request.

Phase Meter

Type 404A phase meter designed by **Advance Electronics Co.**, P.O. Box 394, Passaic, N. J., directly determines the phase angle between two alternating voltages of any waveform, symmetrical or unsymmetrical, from 100 kc down to +0 cycle per second.

The frequency range is 100 kc to +0 cps with an external indicator, and 100 kc to 0.001 cps with panel meter. The phase range is 36°, 90°, 180°, and 360° full scale, lead or lag. Input voltage can be any value between 0.5 to 300 volts from +0 cps to 10 kc, then the lower limit increases slowly up to 1 volt at 100 kc; better sensitivity can be obtained through panel adjustment. The accuracy is ±1 per cent or one degree from +0 cps to 10 kc, then increases slowly up to 4 per cent or four degrees at 100 kc with external indicator; an additional error of +1.5 per cent at any operating frequency with panel meter. Any symmetrical or unsymmetrical periodic waveform does not affect the accuracy of the instrument.

Two New Tubes

Raytheon Mfg. Co., Receiving Tube Div., 55 Chapel St., Newton 58, Mass., announced the addition of receiving tube types 6AJ4 and 6SN7GTA, and picture tube types 21AP4 and 21MP4.

The 6AJ4 is a 9 pin miniature triode designed for use as a grounded-grid amplifier in UHF television receivers.

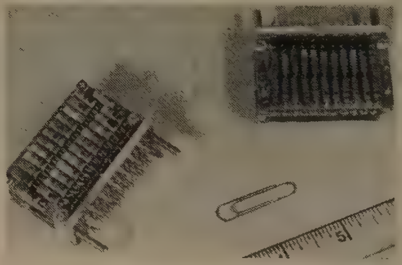
The 6SN7GTA is a dual triode designed for use as a combined vertical oscillator and vertical deflection amplifier in television receivers.

The 21AP4 is a 21 inch rectangular-faced television picture tube with a metal envelope. It employs a spherical frosted filter glass face plate and is magnetically focused and deflected.

The 21MP4 is a 21-inch metal envelope, rectangular-faced television picture tube, employing a frosted filter glass face plate, magnetic focus and magnetic deflection.

Magnetic Storage Register

The parallel magnetic storage system developed by **The Jacobs Instrument Co.**, Bethesda 14, Maryland, in 1949, and tested in 1950, is now offered commercially for the first time.



This type of register involves parallel read-in and read-out, and involves the use of no power to keep information in storage. The amount of energy required for read-in or read-out (7×10^{-7} watt second per digit for No. D1143A, and 4×10^{-6} watt-second per digit for No. D1143B) is small.

The magnetic cores are pulsed once, simultaneously, to insert information into them, and then are left quiescent. They are all pulsed again, simultaneously, to extract information. Information remains in them for an indefinite period of time without the consumption of power.

With the D1143A type, a 24-digit number can be read into storage in 8 microseconds, and read out in 3 microseconds. With the D1143B register, a 24-digit number can be read into storage in 0.8 microsecond, and read out in 0.5 microsecond. These speeds are attainable with external circuitry.

A complete 24-digit register, which contains 24 storage elements plus their 24 gating circuits, measures $\frac{3}{4}$ inch×1 7/16 inches×$2\frac{1}{8}$ inches. This register plugs directly into a mounting panel. As many such registers as are desired may be plugged into such a panel.

(Continued on page 18A)

RR Germanium Transistors and Diodes

FOR EVERY PURPOSE!

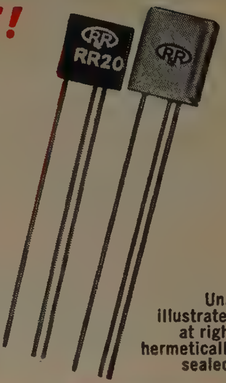
RR PNP JUNCTION TRANSISTORS

PNP JUNCTION TRANSISTORS
(Typical Characteristics at 25° C—Grounded Emitter)

TYPE NO.	RR14‡	RR20‡	RR21‡
Collector Voltage—volts	−1.5	−1.5	−15.0
Collector Current—ma	−0.5	−0.5	−3.0
Ico—Microamp.*	10	10	30
Current Amplification	25	40	25
Power Gain—db	30	40	—
Noise Factor—db (1 Kc)	22	22	—
Power out—mw (10% Dist.)†	—	—	20.0

* $I_e = 0$, $V_c = -1.5$ volts.
† With 1000 ohm driving impedance and 5000 ohm load.
‡ RR14H, RR20H and RR21H are hermetically sealed types.

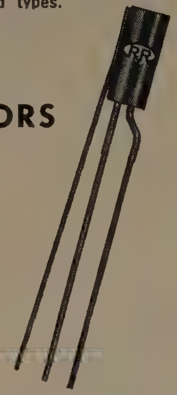
Tiny, stable high gain units, most economical of power, may be soldered in place or socketed in a recommended RTMA transistor socket. They are suitable for audio amplifiers, servo amplifiers and transformer coupled carrier amplifiers. Available in plastic or hermetically sealed in metal and glass.



Unit illustrated at right hermetically sealed.

RR POINT CONTACT TRANSISTORS

Available in a variety of stable controlled types suitable for both fast and medium speed switching circuits and high frequency amplifiers. Advanced mechanical design for economical production . . . Heat conducting metal case; standard basing, choice of solder-in or plug-in.



POINT CONTACT TRANSISTORS
Typical Characteristics at 25° C

SWITCHING TRANSISTORS

TYPE NO.	R1698	R1734
Off Collector Current max. ma ($I_e = 0$)	−2.2 (@ $V_c = 40V$)	−0.7 (@ $V_c = -7V$)
On Collector Voltage max. volts ($I_e = 3.0$)	−4.0 (@ $I_c = 5.5$ ma)	−1.2 (@ $I_c = -4.0$ ma)
Collector Dissipation max. m w	120	120
Nominal cut-off Frequency m c	1.5	10.0

GENERAL PURPOSE TRANSISTOR

TYPE NO.	R1729
Collector Voltage—volts	−30
Emitter Current—ma	1.0
Input Resistance (R_{11})—ohms	190
Output Resistance (R_{22})—ohms	6000
Current Amplification Factor	2.5
Nominal Cut-off Frequency—mc	5.0

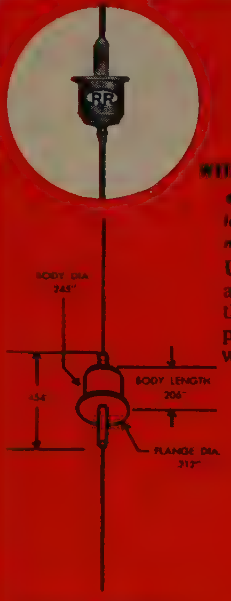
Our engineers will be glad to offer suggestions regarding your Germanium Transistor and Diode applications without obligation . . . Write to Section P

RR JUNCTION POWER DIODES

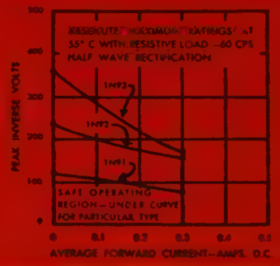
WITH THESE DISTINGUISHING CHARACTERISTICS

• Very low forward drop • Low reverse leakage • Tiny •. Hermetically sealed in metal and glass.

Useful in power supplies, magnetic amplifiers and telephone systems, etc., they have the characteristics of large plate-type power rectifiers and size and weight of a small circuit component.



SHOWN APPROXIMATELY ACTUAL SIZE



JUNCTION POWER DIODES
Maximum Ratings at 55° C—Resistive Load

TYPE NO.	1N91	1N92	1N93
Peak Inverse Voltage (volts)	100	200	300
Peak Forward Current (ma)	470	310	230
D.C. Output Current (ma)	150	100	75
Voltage Drop at Full Load (volts)	0.5	0.5	0.5
Surge Current (amps)	25	25	25
Reverse Working Voltage (continuous volts)	30	65	100
Max. Freq. of Operation (kc)	50	50	50

Coming . . .

RR JUNCTION POWER TRANSISTORS

. . . For Audio power up to 2 watts

RR PHOTO TRANSISTORS

. . . To operate power relay with one junction transistor as DC amplifier.

SELETRON & GERMANIUM DIVISION
RADIO RECEPTOR COMPANY, INC.
RR *Since 1922 in Radio and Electronics* RR
SALES DEPT: 251 W. 19th St., New York 11, N. Y. • FACTORY: 84 N. 9th St., Brooklyn 11, N. Y.

ATR

Makes it easy to DEMONSTRATE and TEST D.C. apparatus from A.C. lines *with* "A" BATTERY ELIMINATORS

for Demonstrating and Testing Auto Radios

6 volt or 12 volt!

New Models . . . Designed for testing D.C. Electrical Apparatus on Regular A.C. Lines. Equipped with Full-Wave Dry Disc Type Rectifier, Assuring Noise-less, Interference-Free Operation and Extreme Long Life and Reliability.

See your jobber or write factory

√ NEW MODELS √ NEW DESIGNS √ NEW LITERATURE

"A" Battery Eliminators, DC-AC Inverters, Auto Radio Vibrators

ATR

AMERICAN TELEVISION & RADIO CO.

Quality Products Since 1931

SAINT PAUL 1, MINNESOTA—U. S. A.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 12A)

Miniature Twin Triode

A miniature twin triode designed for service in low noise vhf cascode television amplifiers, designated Type 6BZ7, is now being manufactured by the **Radio Tubes Div., Sylvania Electric Products Inc.,** Emporium, Pa.

The 6BZ7 consists of two independent medium mu triodes contained in a T-6½ envelope. The tube features increased cascode tuner gain and higher mutual conductance than the Type 6BQ7, which is otherwise similar. Internal shielding between sections reduces internal coupling and thus makes the Type 6BZ7 especially suited for use in cascode amplifiers and other applications in which a minimum of coupling between the two sections is required.

The double triode construction of the Sylvania Type 6BZ7 provides increased efficiency with a reduction in cost, size, and circuit complexity of vhf tuners.

Square Wave Generator

A new, compact, stable, inexpensive square wave generator is available from **American Electronic Laboratories, Inc.,** 641 Arch Street, Philadelphia, Pa. Designed for use as a modulator for radio frequency measurements, it is useful for general experimentation wherever a 1,000 or 400 cps square wave is required.

The generator produces a square wave at either 400 or 1,000 cps tuneable over a ±10 per cent range by means of a front panel control. The output is adjustable in amplitude from 0 to 50 volts peak-to-peak, no load, or 12 volts peak-to-peak into a 600 ohm load. Both amplitude and frequency are constant within ±2 per cent for line voltage variations from 105 to 120 volts.

The generator provides a stable method of externally modulating the rf output of a signal generator through a crystal modulator when carrying out precise standing wave measurements, Q measurements and other tests requiring absence of frequency modulation and high modulation efficiency. Powered from 115 volts, 60 cps, the unit is an 8×8×8 inches sloping front cabinet with carrying handle.

(Continued on page 117A)

Helipot

Single Turn

First in precision potentiometers

Here are three models of single turn, continuous rotation Helipots . . . each available *from stock* in a wide range of resistance values. All three feature the rugged dependability . . . the high degree of precision . . . the proven design characteristics . . . that you expect of every Helipot. Among their many features are the copper mandrel which effectively dissipates heat . . . the spot-welded connections (no pressure-type connections are used in *any* Helipot model) . . . the provision for easy, accurate phasing *on the job* . . . the wide choice of mounting styles, number of ganged sections, number of additional tap connections, etc. And like all Helipot models, they are available in variations to meet your exact specifications.

The versatility of these three series of single turn, continuous rotation Helipots makes them ideal for such uses as servo systems . . . analog computers . . . pH indication and control . . . level indication and control . . . telemetering circuits . . . color analysis and control . . . navigation aids . . . radar indicators . . . laboratory instruments, and many more. Your particular requirements will determine the model . . . the number of ganged sections . . . the number and placement of tap connections . . . the style of mounting . . . and other characteristics best suited to your needs.

Every Helipot series is available in variations to meet your exact specifications. Our engineering department will gladly give you every assistance . . . in adapting standard Helipots to your particular requirements . . . in building entirely new Helipots to meet your needs.

Below is a Quick-Reference-Guide to the J, L, and Y Series Helipots.
For complete information, write for Data File **606.**

	Model Y Series (a)	Model J Series	Model L Series
Diam.	1¾″	2″	3″
Resist. Range	50—50,000 ohms (b)	50—50,000 ohms (b)	50—100,000 ohms (b)
Power Rating	2.5 watts	4 watts	5 watts
Active Elec. Rotation	356° ±1°	357° ±1°	358° ±1°
Coil Length	4.6″	5″	8″
Mounting	Y—Threaded Bushing. YS—Servo Flange, Sleeve Bearing. YSP—Servo Flange, Ball Bearing. YF—Two-hole Servo, Sleeve Bearing. YFP—Two-hole Servo, Ball Bearing.	Threaded Bushing (Spec.). Servo Flange, Ball Bearing (Std.).	L—Threaded Bushing. LS—Servo Flange, Sleeve Bearing. LSP—Servo Flange, Ball Bearing.
Max. No. Ganged Sections (c)	14	8	8
Max. No. Tap Connections per Section (c)	17	21	33

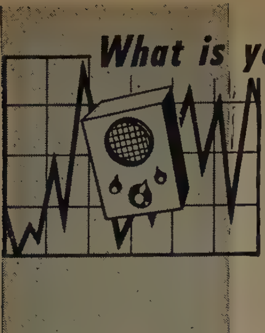
(a) Model Y Series Helipots are available in both linear and non-linear versions.
(b) Higher or lower resistance values can be furnished on special order.
(c) Sections can be ganged and tap connections added, during manufacture.

Helipot DIVISION

BECKMAN INSTRUMENTS, INC.
SOUTH PASADENA, CALIFORNIA

PLANTS IN SO. PASADENA, CALIF. AND MOUNTAINSIDE, N. J. REPRESENTATIVES IN PRINCIPAL CITIES

What is your Delay or Regulating Problem?



For the most effective solution use the
SIMPLEST, MOST COMPACT
MOST ECONOMICAL
HERMETICALLY SEALED

AMPERITE

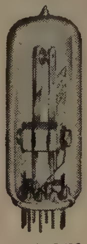
THERMOSTATIC DELAY RELAYS

Provide delays ranging from 2 to 120 seconds.

- Actuated by a heater, they operate on A.C., D.C., or Pulsating Current.
- *Hermetically sealed.* Not affected by altitude, moisture, or other climate changes.
- Circuits: *SPST only*—normally open or normally closed.

Amperite Thermostatic Delay Relays are compensated for ambient temperature changes from −55° to +70°C. Heaters consume approximately 2 W. and may be operated continuously. The units are *most compact, rugged, explosion-proof, long-lived, and—very inexpensive!*

STANDARD



MINIATURE

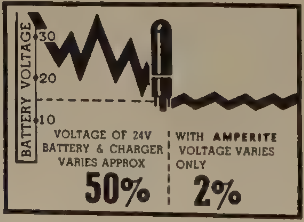
TYPES: Standard Radio Octal, and 9-Pin Miniature.

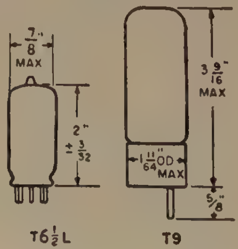
PROBLEM? Send for Bulletin No. TR-81

BALLAST-REGULATORS

- **A**mperite Regulators are designed to keep the current in a circuit ***automatically regulated*** at a definite value (for example, 0.5 amp).
- For currents of 60 ma. to 5 amps. *Operates on A.C., D.C., or Pulsating Current.*
- Hermetically sealed, light, compact, and most inexpensive.

T9 BULB





T6½L T9

Maximum Wattage Dissipation: T6½L—5W. T9—10W.

Amperite Regulators are the simplest, most effective method for obtaining ***automatic regulation*** of current or voltage. ***Hermetically sealed,*** they are not affected by changes in altitude, ambient temperature (−55° to +90°C), or humidity. Rugged; no moving parts; changed as easily as a radio tube.

Write for 4-page Technical Bulletin No. AB-51

AMPERITE CO., Inc. 561 Broadway, New York 12, N. Y.
In Canada: Atlas Radio Corp., Ltd., 560 King St., W., Toronto 2B

Industrial Engineering Notes*

INDUSTRY STATISTICS

The production of television sets in February established a new record for that month, according to industry estimates compiled by the RTMA Statistical Department....................

Over one million radios were produced during the month, well above the level of February 1952. Total television production for February was estimated at 730,597 sets compared with 409,337 in the same month last year. Output of TV sets in January had been estimated at 719,234 units. Radio production in February totaled 1,192,439 units compared with 759,453 sets manufactured in the same 1952 month. During January RTMA estimated that 1,093,142 radios were produced. **The manufacturers' value of radio and television sets manufactured during 1952 was estimated by the RTMA Statistical Department recently to have exceeded $1.2 billion............................**

The total manufacturers' value of $1,298, 847,000 is comprised of $1,049,000,000, for 6,096,279 television sets and $249,847,000, based on a revised radio production figure of 10,934,872 units. The revised 1952 radio production includes 4,043,128 home sets, 1,929,036 clock radios, 1,719,859 portables and 3,242,849 auto radios.

MOBILIZATION

Rep. John W. McCormack (C., Mass.) introduced a bill (HR 4304) to amend the National Security Act of 1947 and related laws so as to provide for an Assistant Secretary of Defense for Research and Development, to include a corresponding officer for each of the military departments and for the creation of a Defense Research Council.............................

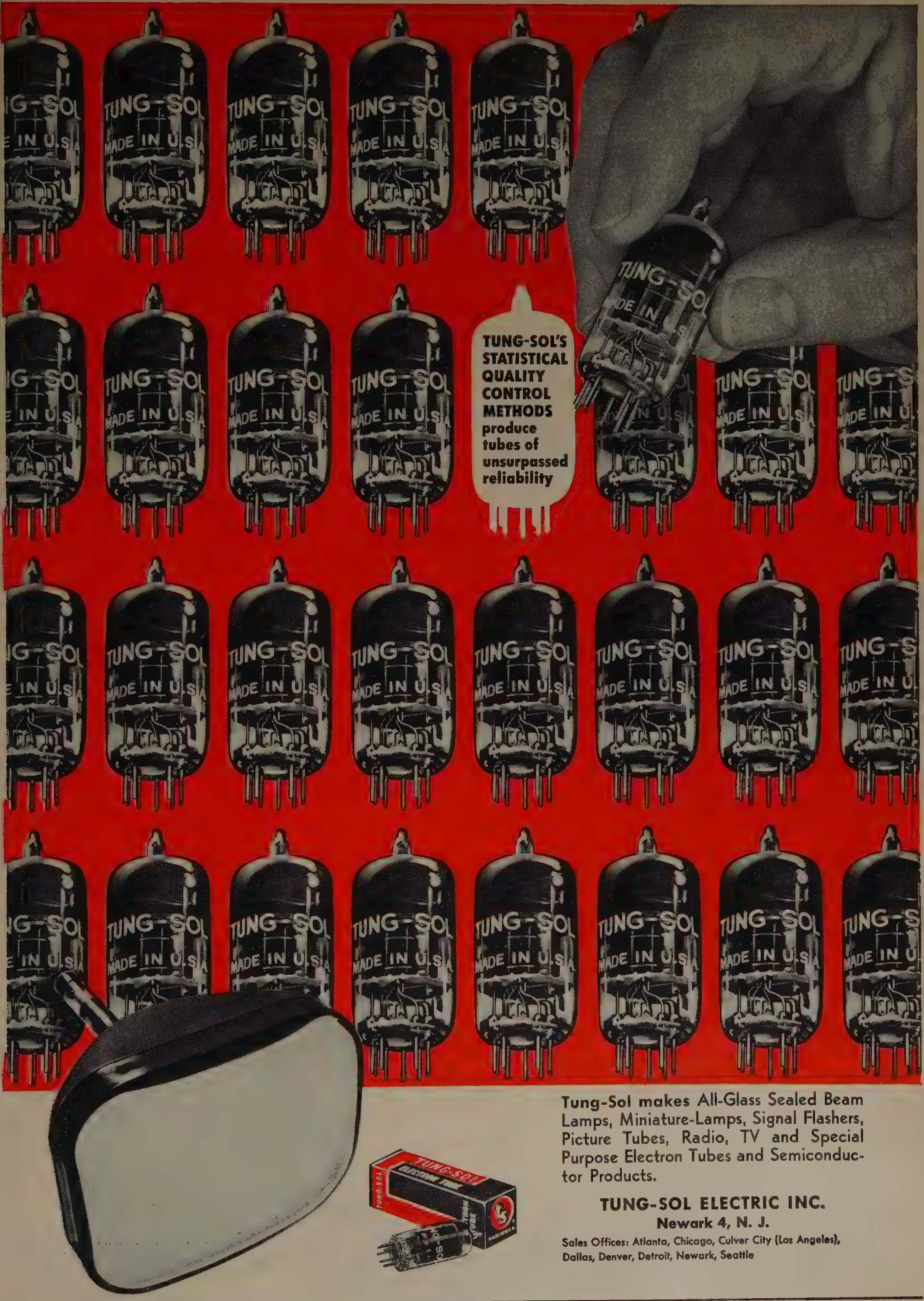
If passed, the bill provides that the newly created post of Assistant Secretary of Defense for Research and Development shall co-ordinate and supervise all research and development operations of the Department of Defense, and establish policies and procedures to be followed in carrying out such operations. The bill would also establish an Assistant Secretary of the Army, Navy, and Air Force for Research and Development. In amending the National Security Act of 1947, the bill would establish in the Department of Defense a Defense Research Council, composed of the Assistant Secretary of Defense for Research and Development and the Assistant Secretaries of the Army, Navy, and Air Force for Research and Development. . . .

The Atomic Energy Commission recently released an additional 15 patents, including several in the electronics field. Non-exclusive, royalty-free licenses on the listed patents will be granted by the Commission as part of its program to make non-secret technological information available for use by industry...................

(Continued on page 68A)

---

* The data on which these NOTES are based were selected by permission from *Industry Reports,* issues of March 27, April 3, April 10, and April 20, 1953, published by the Radio-Television Manufacturers Association, whose co-operation is gratefully acknowledged.


TUNG-SOL'S STATISTICAL QUALITY CONTROL METHODS produce tubes of unsurpassed reliability
TUNG-SOL
MADE IN U.S.A.
TUNG-SOL ELECTRON TUBE

Tung-Sol makes All-Glass Sealed Beam Lamps, Miniature-Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

TUNG-SOL ELECTRIC INC.
Newark 4, N. J.

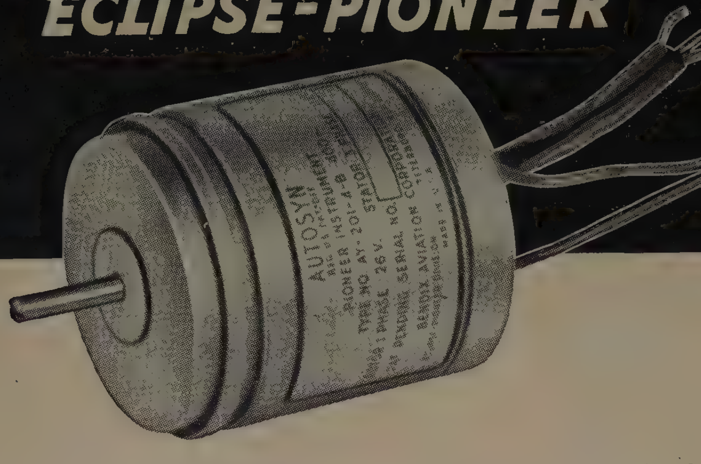
Sales Offices: Atlanta, Chicago, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Seattle

Autosyn*

SYNCHROS

Precision-Built by

ECLIPSE-PIONEER



For more than 18 years, Eclipse-Pioneer has been a leader in the development and production of high precision synchros for use in automatic control circuits of aircraft, marine and other industrial applications. Today, thanks to this long experience and specialization, Eclipse-Pioneer has available a complete line of standard (1.431″ dia. X 1.631″ lg.) and Pygmy (0.937″ dia. X 1.278″ lg.) Autosyn synchros of unmatched precision. Furthermore, current production quantities and techniques have reduced cost to a new low. For either present or future requirements, it will pay you to investigate Eclipse-Pioneer high precision at the new low cost.

*REG. TRADE MARK BENDIX AVIATION CORPORATION

AVERAGE ELECTRICAL CHARACTERISTICS—AY-200 SERIES**

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes
Transmitters	AY201-1	26V, 400~, 1 ph.	225	1.25	25+j115	11.8	9.5	3.5	15
	AY201-4	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	20
Receivers	AY201-2	26V, 400~, 1 ph.	100	0.45	45+j225	11.8	16.0	6.7	45
Control Trans-formers	AY201-3	From Trans. Autosyn	Dependent Upon Circuit Design				42.0	10.8	15
	AY201-5	From Trans. Autosyn	Dependent Upon Circuit Design				250.0	63.0	15
Resolvers	AY221-3	26V, 400~, 1 ph.	60	0.35	108+j425	11.8	53.0	12.5	20
	AY241-5	1V, 30~, 1 ph.	3.7	—	240+j130	0.34	239.0	180.0	40
Differentials	AY231-3	From Trans. Autosyn	Dependent Upon Circuit Design				14.0	10.8	20

**Also includes High Frequency Resolvers designed for use up to 100KC (AY251-24)

AY-500 (PYGMY) SERIES

	Type Number	Input Voltage Nominal Excitation	Input Current Milliamperes	Input Power Watts	Input Impedance Ohms	Stator Output Voltages Line to Line	Rotor Resistance (DC) Ohms	Stator Resistance (DC) Ohms	Maximum Error Spread Minutes
Transmitters	AY503-4	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	25.0	10.5	24
Receivers	AY503-2	26V, 400~, 1 ph.	235	2.2	45+j100	11.8	23.0	10.5	90
Control Trans-formers	AY503-3	From Trans. Autosyn	Dependent Upon Circuit Design				170.0	45.0	24
	AY503-5	From Trans. Autosyn	Dependent Upon Circuit Design				550.0	188.0	30
Resolvers	AY523-3	26V, 400~, 1 ph.	45	0.5	290+j490	11.8	210.0	42.0	30
	AY543-5	26V, 400~, 1 ph.	9	0.1	900+j2200	11.8	560.0	165.0	30
Differentials	AY533-3	From Trans. Autosyn	Dependent Upon Circuit Design				45.0	93.0	30

For detailed information, write to Dept. G.

ECLIPSE-PIONEER DIVISION of
Bendix
AVIATION CORPORATION
TETERBORO, NEW JERSEY

Export Sales: Bendix International Division, 72 Fifth Avenue, New York 11, N. Y.

Industrial Engineering Notes

(Continued from page 66A)

Applicants for licenses should apply to the Chief, Patent Branch, Office of the General Counsel, U. S. Atomic Energy Commission, Washington 25, D. C., identifying the subject matter by patent number and title. The following patents of interest to the electronics industry were released: Amplifier Circuit for Testing: 2,628,268; Shielded Switch Assembly: 2,628,297; Portable Voltage Supply for Radiation Counters: 2,628,338; Comparative Photometer: 2,626,989; Tachometer: 2,630,529; Flow Valve Control: 2,628,638; Radioactive Resistor: 2,629,837; Remote Control Manipulator: 2,632,574; and Electrical Apparatus and Method: 2,633,540.

……

Secretary of the Army Robert T. Stevens recently announced the initiation of action to establish antiaircraft battalions equipped with electronically-controlled NIKE guide missiles. Considered by the Army to be essential in defending the U. S. from air attack, the NIKE can be fired to high altitudes and can successfully attack enemy aircraft and missiles traveling at supersonic speeds. Thus, the missile provides a valuable supplement to the Army's electronically-operated Skysweeper antiaircraft guns. The Atomic Energy Commission also reported it has successfully entered its first phase of operation in testing the new submarine thermal reactor for the USS Nautilus at the AEC National Reactor Testing Station in Idaho.

Technical

The March issue of the "Bibliography of Technical Reports" published by the Office of Technical Services, Department of Commerce, lists new manufacturing processes and significant developments for the electronics industry. The following are available from the Library of Congress, Photoduplication Section, Washington 25, D. C., for the reported amount:

"Automatic High-speed Computing, A Progress Report on the EDVAC." PB 108394. Microfilm $4.75, photostat $15.00

"Bibliography of Reports on Tropospheric Propagation," PB 108151. Microfilm, $9., photostat, $3.75.

"Diffraction by a Cylindrical Obstacle," PB 108467. Microfilm, $2.00, photostat, $3.75.

"Electrets, Report for Period June 1, 1952, to Aug. 31, 1952," PB 108219. Microfilm $2., photostat $3.75.

"Evaluation of Contacts," PB 108477. Microfilm, $2.50, photostat, $6.25.

"K-Band Germanium Crystals," PB 108183. Microfilm, $1.25, photostat, $1.25.

"Measurement and Interpretation of Antenna Scattering," PB 108409. Microfilm, $2.25, photostat, $5.00.

"Mechanical Shock Characteristics of High Impact Machines for Electronic Devices (Taft-Pierce Manufacture)," PB 108155. Microfilm, $2.50, photostat, $6.25.

(Continued on page 69A)

7

REASONS WHY

Precision

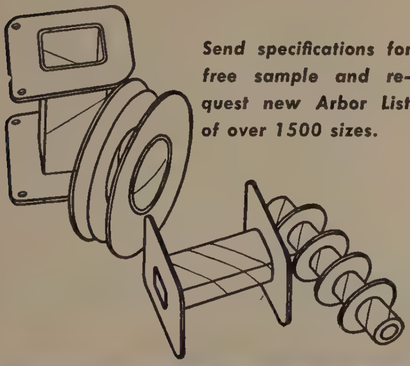
COIL BOBBINS

improve your coils . . .

- Quality Controlled
- Greater Insulation
- Better Heat Dissipation
- Higher Moisture Resistance
- 15 to 20% Stronger
- Lighter Weight
- More Winding Space

PRECISION Coil Bobbins are finished to your exact specifications. Only the finest dielectric materials are used.

Cores furnished in an infinite variety of sizes and shapes—kraft, fish paper, acetate, or combinations. Flanges cut to specifications—plain or fitted with leads, slots or holes; embossed or recessed.



Send specifications for free sample and request new Arbor List of over 1500 sizes.

PRECISION PAPER TUBE CO.

2051 W. Charleston St. Chicago 47, Ill.
Plant No. 2, 79 Chapel St., Hartford, Conn.
Also Mfrs. of Precision Paper Tubes

Industrial Engineering Notes

(Continued from page 68A)

"Microwave Properties of Precipitation Particles," PB 108230. Microfilm, $2.50, photostat, $6.25.

"Miniaturized Pulse Cable," PB 107723. Microfilm, $2., photostat, $3.75.

"New Type Safety Interlock Switch," PB 108224. Microfilm, $1.75, photostat, $2.50.

"Note on the Effect of a Video Filter on the Detection of Pulsed Signals in Noise," PB 108416. Microfilm, $2.00, photostat, $3.75.

"Nuclear Magnetic Moment of S-33 from Microwave Spectroscopy," PB 108130. Microfilm, $1.75, photostat, $2.50.

"On Radiation and Radiating Systems in the Presence of a Dissipative Medium," PB 108464. Microfilm, $2.25, photostat, $5.

"Precipitation Trajectories and Patterns," PB 108231. Microfilm, $2.00, photostat, $3.75.

"Principles of Crystal Rectifiers," PB 108184. Microfilm, $2.50, photostat, $6.25.

"Properties of Long Antennas," PB 108400. Microfilm, $2., photostat, $3.75.

"Services, Facilities and Materials Required for Investigations and Studies on Synthetic Resinous Materials," PB 108166. Microfilm, $2.50, photostat, $6.25.

"Stabilization of a Microwave Oscillator with an Ammonia Absorption Line Reference." PB 108457. Microfilm, $3.75, photostat, $11.25.

"Terminal Impedance and Generalized Two-wire Line Theory." PB 108462. Microfilm, $2.25, photostat, $5.00.

"Theory and Design of Voltage Compensators, Vol. 2," PB 108256. Microfilm, $6.50, photostat, $22.50.

"Traveling Waves and Unsymmetrically Fed Antennas," PB 108408. Microfilm, $2.75, photostat, $7.50. . . .

The Underwriters' Laboratories Inc. recently circulated information to industry on its studies of printed circuit radio receivers. . . . .

The material was circulated to the Electrical Council of Underwriters' Laboratories Inc. and manufacturers of listed power-operated radio and television receiving applicances. The bulletin points out that approximately six months ago a number of manufacturers submitted several designs of printed circuit radio receivers to the Laboratory for testing. It outlines the general characteristics of the units tested, the tests applied and the results obtained. The bulletin, covering Subject 492, concludes as follows: "The printed circuit receivers employing tapped heater rectifier circuits and constructed as described above have been found to comply with present requirements and are being listed under the Special Service of Underwriters' Laboratories Inc."

NATIONAL BUREAU OF STANDARDS ISSUES NEW PUBLICATION

The National Bureau of Standards an-

(Continued on page 70A)

When you need a
PORTABLE
OSCILLATOR

SIE

MODEL MB-1 IS YOUR ANSWER

low distortion battery operated

There are no components of power-line frequency in its output and no transients due to fluctuations in the supply voltages. The small, compact design of this completely portable sine wave generator adapts it to a wide field of usefulness. Frequency range is from 2 to 20,000 CPS with low distortion. A circuit with battery saving features is incorporated in the instrument, so that when maximum signal amplitude is not necessary, less current is drawn from the battery.

SPECIFICATIONS

FREQUENCY RANGES: 2 to 20,000 CPS
DISTORTION: Less than 1% at any frequency in the audio range
CALIBRATION: Within 2% of indicated frequency
FREQUENCY STABILITY: 1% on all ranges
AMPLITUDE STABILITY: 5%
OUTPUT: 2.5 V into a 2,000 ohm load
OUTPUT IMPEDANCE: Approximately 400 ohms at 1,000 CPS
BATTERY LIFE: In excess of 100 hours when used in intermittent service
WEIGHT: With batteries — 30 lbs.
DIMENSIONS: With lid in place — 12" x 12" x 11"
FINISH: Black Anodized Aluminum Panel with Gray Wrinkle Baked Enamel Case

SOUTHWESTERN INDUSTRIAL
ELECTRONICS COMPANY

WHEN A SINGLE SCOPE WON'T DO YOUR JOB!

Try to compare four different but related phenomena . . . at the same instant . . . under the same conditions . . . with single channel oscilloscopes . . . and you run into trouble. Nine times out of ten, you'll miss those high speed signals.

There are several ETC oscilloscopes that lick the problem by displaying *four* phenomena on the face of a single 5" tube. Since their development they have opened new fields in electronic and medical research, strain and vibration analysis, seismography and ballistics.

Each of their four channels has independent controls for intensity, focus, and positioning of the X and Y axes. All input signals can be observed on a common time base or on separate time bases if desired. Wide band, high gain, DC or AC amplifiers are provided on both the vertical and horizontal axes.

ETC

Details about the four-channel models available as well as others with 2, 5, 6, 8, or even 10 channels are covered in our catalog. Write for your copy today.

electronic tube corporation
1200 E. MERMAID LANE, PHILADELPHIA 18, PA.

Industrial Engineering Notes

(Continued from page 69A)

nounced recently the issuance of a new publication, "Radio Frequency Power Measurements." This NBS Circular 536 presents a comprehensive survey of the methods currently in use and gives a brief discussion of the theoretical background, practical limitations, and advantages of radio-frequency power as applied to medicine, industry, navigational devices and scientific research. It is available at the Government Printing Office, Washington 25, D. C., for 15 cents a copy.

FEDERAL PERSONNEL

Capt. Henry Bernstein, Bureau of Ships Deputy for Electronics, is to relieve Capt. D. P. Tucker, Commander Officer and Director of the Naval Electronics Laboratory, San Diego, Calif. The change in command is to take place in mid-May. Prior to his last assignment with the Bureau of Ships, Capt. Bernstein served as Director of the Armed Services Electro Standards Agency at Fort Monmouth, N. J. No announcement has been made as to his successor. . . . .

President Eisenhower named John C. Doerfer, Chairman of the Wisconsin Public Service Commission, to succeed Eugene H. Merrill as a Commissioner of the FCC. Mr. Doerfer's name has been sent to the Senate, where confirmation is expected shortly. . . . .

The President also named FCC Commissioner Rosel Hyde Chairman of the Federal Communications Commission. He was named to the chairmanship for a one year period although he was just returned to the Commission last year for another seven year term. Mr. Hyde replaces Paul A. Walker in the Chairmanship. . . . .

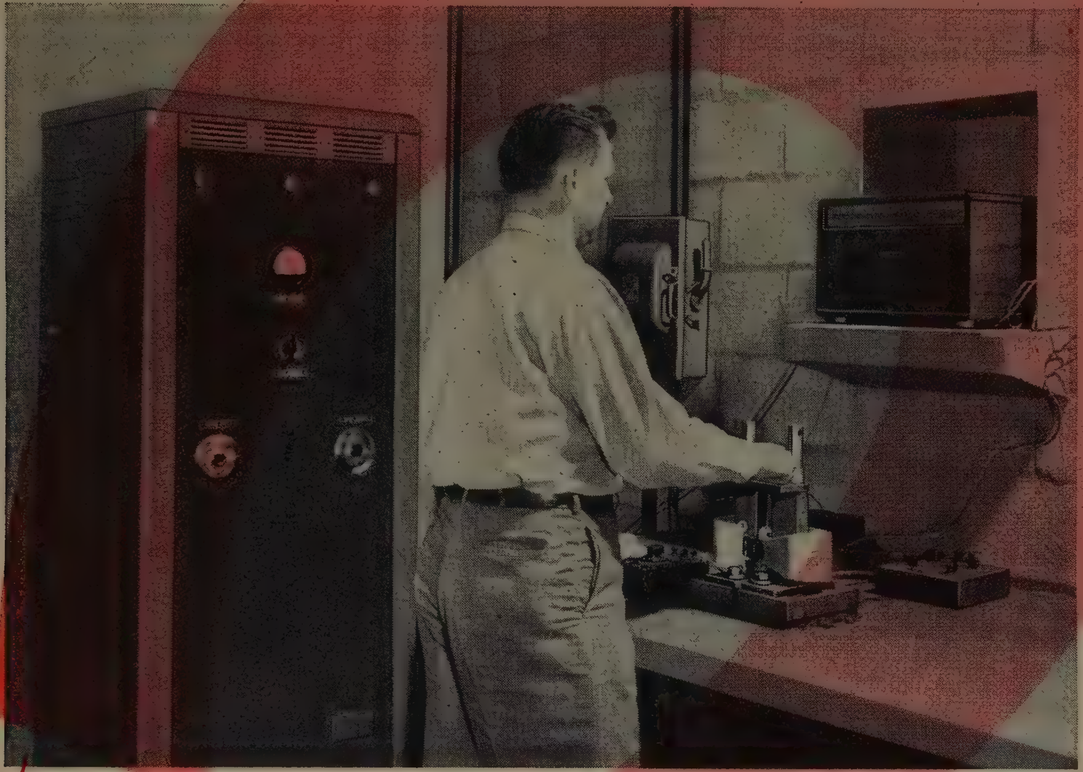
Dr. A. E. Robertson has been named Chief of the Mechanisms and Services Division of the Fuse Department at the Naval Ordnance Laboratory. A. B. Dietemann, formerly of the Fuse Department Office, has been named Deputy Chief.

IMPROVED MAGNETIC AMPLIFIERS DETAILED IN NEW OTS REPORT

The Office of Technical Services, Department of Commerce, announced recently that, information on a new magnetic amplifier circuit which makes possible better computers and automatic control systems is available to the electronics industry and the public in a group of three government research reports. Naval Research Laboratory scientists evolved a new theory of the action of magnetic amplifiers which make possible magnetic amplifier circuits of very fast response. Also outlined is how the new magnetic amplifier circuits can provide more dependable elements than conventional vacuum tube amplifiers in the following basic functional components of computers: coincidence counters, ring counters and flip-flops. Since a requirement of many automatic control systems is that they be able to "anticipate" changes in the thing being controlled,

(Continued on page 72A)

. . . Another Crucible Service for Magnet Users



160,000

ampere turn,

impulse magnetizer

now available

Magnet users are reducing manufacturing costs and improving their products through the use of this new, capacitor discharge-type, impulse magnetizer — another example of Crucible's leadership in serving industry.

This Crucible development has an improved firing circuit . . . is more compact . . . requires less maintenance . . . and results in more efficient magnetization.

For further information on the availability and operation of the Crucible Impulse Magnetizer, write to Crucible Steel Company of America, General Sales Offices, Oliver Building, Pittsburgh, Pa.

CRUCIBLE first name in special purpose steels

53 *years of Fine steelmaking* **ALNICO PERMANENT MAGNETS**

CRUCIBLE STEEL COMPANY OF AMERICA, GENERAL SALES OFFICES, OLIVER BUILDING, PITTSBURGH, PA.

STAINLESS • REX HIGH SPEED • TOOL • ALLOY • MACHINERY • SPECIAL PURPOSE STEELS

TRANSFORMERS

HERMETICALLY SEALED
TO MIL-T-27 SPECIFICATIONS

NYT offers a wide variety of transformer types to meet military and civilian specifications, designed and manufactured by specialists in transformer development.

Latest NYT service for customers is a complete test laboratory equipped and approved for on-the-spot MIL-T-27 testing and faster approvals.

NEW YORK
TRANSFORMER CO., INC.
ALPHA, NEW JERSEY

Industrial Engineering Notes

(Continued from page 70A)

NRL scientists show in the reports how these new magnetic amplifier circuits can be used to provide such an anticipatory correction mechanism. The three reports, "On the Control of Magnetic Amplifiers," PB 105747; "The Single-Core Magnetic Amplifier as a Computer Element," PB 111033, and "Lead Networks Utilizing a Saturable Core Memory," PB 111022, all can be purchased for 50 cents each from the Office of Technical Services, Department of Commerce, Washington 25, D. C.

FCC ACTIONS

Commenting on Dr. Baker's recommendation recently that "the Federal Communications Commission formally recognize the existence of the NTSC and lends its active support to the NTSC program," FCC Chairman Walker said that NTSC "has standing to request the revision" of the Commission's color TV standards and that "any proposal which it advances to the Commission will receive the most careful and objective consideration.".................................

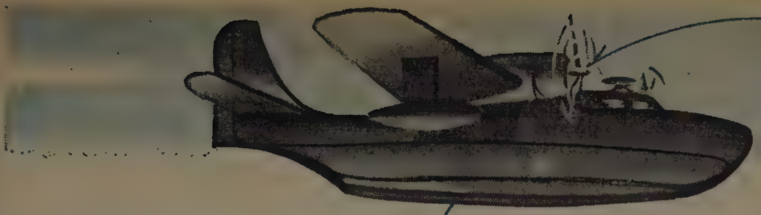
Industry representatives unanimously recommended that the Federal Communications Commission be called upon to review the NTSC color television standard proposals upon completion of current field tests during four days of testimony recently before the House Interstate and Foreign Commerce Committee. Despite differences of opinion as to why the field sequential system standards adopted by the FCC in October, 1951, had not become operative, all witnesses, including the Columbia Broadcasting System, urged a reconsideration of the color television issues by the FCC at an appropriate time in order to expedite the commercialization of color television and to put an end to public confusion.........

The FCC finalized its proposal amending Part 2 of its Rules so as to delete, effective February 1, 1954, the provisions permitting remote pickup broadcast stations to operate on frequencies in the band 2,000–3,500 kc. A new footnote to Section 2.104 (a) also is added permitting the immediate use of frequencies in the band 25.85–26.1 meg. to be authorized in any area for remote pickup of broadcast base and mobile stations on the condition that harmful interference is not caused to the broadcast service. By separate order, the Commission modified the licenses of remote pickup base and mobile stations affected deleting, as of Feb. 1, 1954, the frequencies in the 2,000–3,500 kc band.

WAVEGUIDE PRODUCTION TECHNIQUE OUTLINED IN NEW GOVERNMENT REPORT

A technique for producing strong, lightweight, high-conductivity waveguides by cladding and roll-forming sheet metal is described in a government research report now available to the electronics industry

(Continued on page 74A)



TODAY'S SPECIALIZED CLOSURE
REQUIREMENTS CAN NOW BE
SOLVED ECONOMICALLY
AND DEPENDABLY, FOR—

Standard Cases and Covers are only a part of the role played by HUDSON

SPECIAL SHAPES

Square, rectangular, octagonal and round cans are available at Hudson. All are precision drawn to exact dimensions. Optional features include hole, flanges, lips and many other cost-saving design variations. Sizes range from miniature to extra large. Hudson will cooperate with your design engineers in working out a practical, economical solution to your problem.

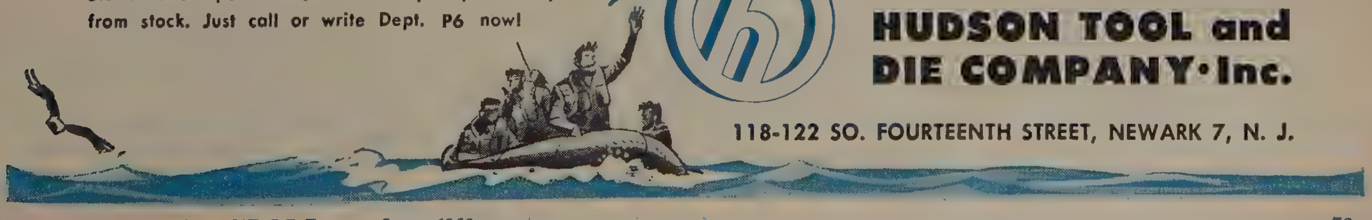
SPECIAL FEATURES

Covers are supplied with a wide variety of design modifications. Hudson covers can include deep or shallow knockouts for headers, holes for terminals and many other special features. Hudson offers the electronic designer custom components at unit costs that reflect mass production methods and economies.

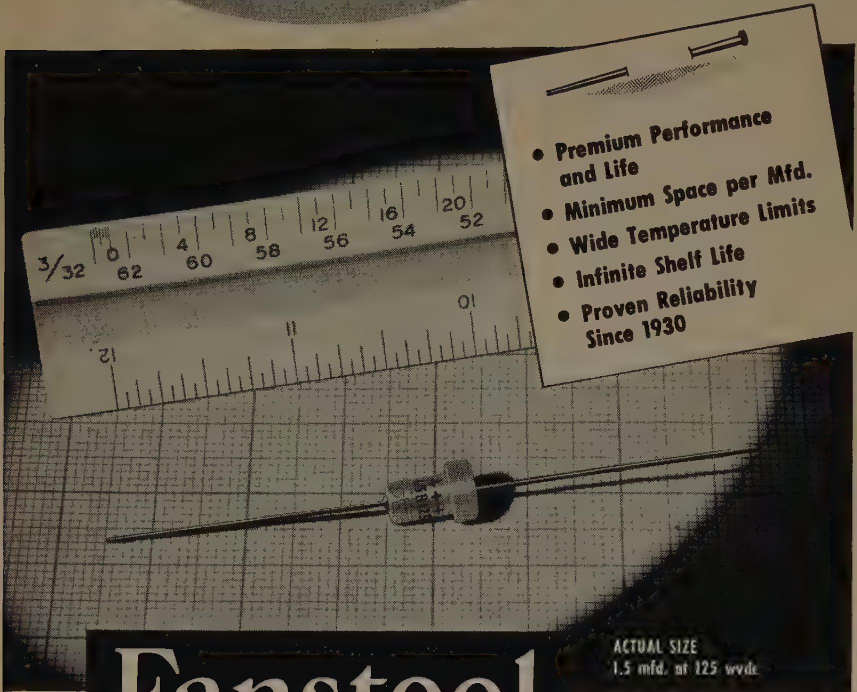
HERE'S HELP FOR ENGINEERS, DESIGNERS AND PRODUCTION MEN! Let Hudson send you the new complete ENGINEERS FILE FOLDER. Lists all Hudson Standard Components available for prompt delivery from stock. Just call or write Dept. P6 now!

HUDSON TOOL and DIE COMPANY·Inc.

118-122 SO. FOURTEENTH STREET, NEWARK 7, N. J.



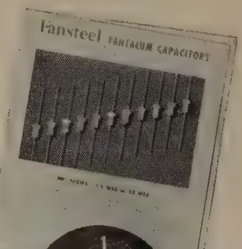
TANTALUM CAPACITORS ARE BASIC
in current electronic trend......


• Premium Performance and Life
• Minimum Space per Mfd.
• Wide Temperature Limits
• Infinite Shelf Life
• Proven Reliability Since 1930
ACTUAL SIZE
1.5 mfd. at 125 wvdc

Fansteel
TANTALUM
CAPACITORS

Now, through the use of tantalum, new high standards of electrolytic capacitor performance are available. The tantalum oxide film is the most stable dielectric, chemically and electrically, yet discovered. As a result, Tantalum Capacitors offer advantages not found in any other electrolytic type—long life, space saving, wide temperature range, excellent frequency characteristics, no shelf aging.

Tantalum Capacitors are made by Fansteel and other leading capacitor manufacturers. Ask for current information bulletins on Fansteel Tantalum Capacitors.



FANSTEEL METALLURGICAL CORPORATION
NORTH CHICAGO, ILLINOIS, U. S. A.
Tantalum Capacitors . . . Dependable Since 1930
32401C

Industrial Engineering Notes

(Continued from page 72A)

and the public. Basically, the technique consists of silver-plating stainless steel strip, roll-forming the strip into a U-section, then resistance-welding two U-sections together, with their mouths facing, to form the closed, rectangular-section waveguide duct. Also described and illustrated in the report are: (1) the roll-forming set-up for converting the flat stainless strip into con-continuous U-shape sections; (2) the resistance-welding technique for joining two U-sections together to form a straight, truly rectangular, unbowed, waveguide duct. The report, "Lightweight Waveguides," PB 107412, is available from the Library of Congress, Photoduplication Section, Washington 25, D. C., for $2.50, on microfilm and $6.25 in photostat form.

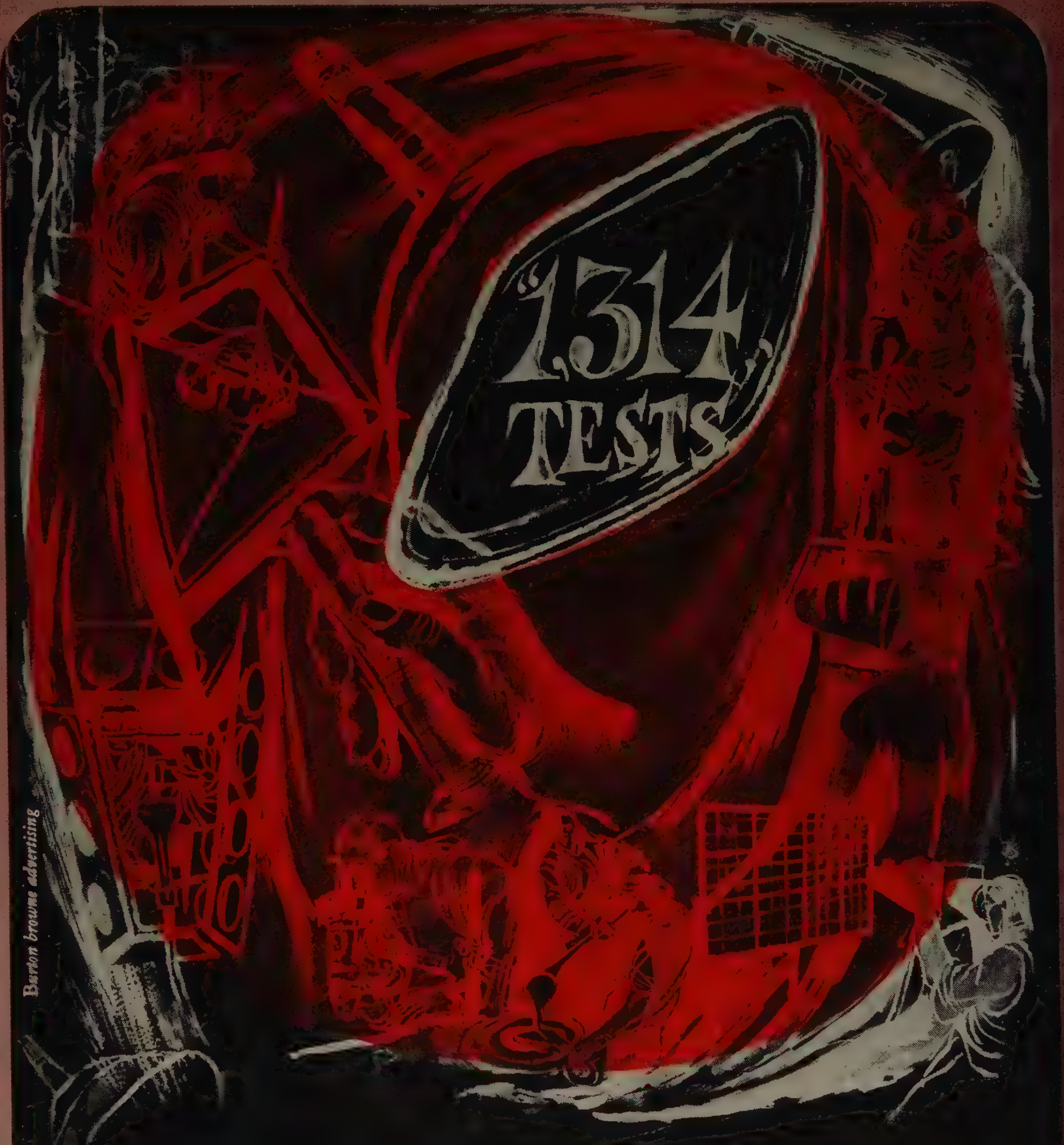
TELEVISION

The Canadian Broadcasting Corporation has approved television transmitting licenses for six applicants. The endorsements will go to the government for final approval, which will be automatic. The applications approved for TV transmitting licenses were: Niagara Television Ltd., to operate a station at Hamilton, Ont., Channel 13; London Free Press Printing Co., Lts., London, Ont., Channel 10; CKSO Radio Limited, Sudbury, Ont., Channel 5; Western Ontario Broadcasting Co., Windsor, Ont., Channel 9; Television de Quebec, Ltd., Quebec City, Channel 4; New Brunswick Broadcasting Co., Ltd., Saint John, N.B., Channel 4; and Cape Breton Broadcasters, Ltd., Sydney, N.S., Channel 4. . . .

A petition for rulemaking was filed recently with the FCC looking toward the creation of a new VHF television broadcast channel between 72–78 meg. by shifting the present channels 5 and 6 upward two megs., and the sharing of VHF television channels between 72 and 90 megs. by operational fixed stations and fixed stations in the Domestic Fixed Public Service. The petition was filed by Bingham, Collins, Porter & Kistler "as members of the Bar of the Federal Communications Commission and on behalf of a number of clients" as part of the Commission's consideration of a new policy to govern the assignment of frequencies in the 72–76 mg. band-Docket No. 10315. The petition outlines various methods and conditions which could be considered in making the change and says:

"The proposal to create Channel 4½ would shift the upper limit of Channel 6 from 88 to 90 meg. and add an additional channel to the five now located between 54 and 88 meg. It is believed that this would not cause any great difficulty or impose any great cost upon owners of existing receivers because (1) receiver tuners have padding, trimming and fine tuning adjustments capable of adjustment over fairly wide ranges, and (2) a large percentage of receivers now in use employ turret-type tuners having replaceable tuning strips. It is suggested that the receiver problem be referred to the Radio-Television Manufacturers Association for study." The petition

(Continued on page 76A)



Quality-checks are a full-time job with Rauland—all the way down the line. From spectographic analysis of tube components to ionization test for vacuum—1,314 tests are your assurance that Rauland meets the highest engineering standards. Test-proved in our factories and laboratories, performance-proved in countless homes…it's plain to see why Rauland is the *proved* profit-getter, too. *The Rauland Corporation, 4245 N. Knox Avenue, Chicago 41, Illinois—Mulberry 5-5000.*

ZENITH Subsidiary

RAULAND

PERFECTION THROUGH RESEARCH

from AMPHENOL'S 5 PLANTS

. . . Come quality components for the electronics industry. AN Connectors, RF Connectors, RG Cables, literally thousands of cataloged parts are being supplied by AMPHENOL to Radio-Electronics manufacturers. And matching a steadily mounting demand for these parts is the increased production of AMPHENOL's five plants. What are the reasons for this demand? Why is AMPHENOL constantly expanding? The answers to these questions are evident to the Electronics industry. They know, first, that behind each part supplied by AMPHENOL stands an unrivaled reputation for *integrity*. Firms that have been customers for twenty years or those that have only recently begun to buy from AMPHENOL recognize this and rely upon it. They know, also, that a direct result of this is the recognized *quality* of AMPHENOL components, parts manufactured of premium material. The *ingenuity* of the AMPHENOL engineering staff —the ability to come up with solutions to seemingly insolvable problems—is well known. Whether it is the engineering of a totally new component or the modification of an existing one, these electronics specialists provide valuable help to industry. *Integrity, quality, ingenuity,* all reasons why the road of confident buying leads, and always has led, to AMPHENOL.

AMPHENOL

AMERICAN PHENOLIC CORPORATION
chicago 50, illinois

"Building to the Future of Electronics"

Industrial Engineering Notes

(Continued from page 74A)

requests that FCC not adopt its present proposal in Docket 10315 but instead institute rule making proceedings looking toward the creation of this new TV channel. . . . .

The Federal Communications Commission approved construction permits for eight new television stations recently, two from noncommercial educational stations and six for commercial outlets, bringing the total outstanding authorizations to 441, including 108 pre-freeze stations and the present 16 educational outlets. The following construction permits were authorized April 1:

Sheldon Anderson, Tulare, Calif., channel 27.
Lewistown BC Co., Lewistown, Pa., channel 38.
Mountain Empire BC Corp., Marion, Va., channel 50.
Barnet Brezner, Alexandria, La., channel 62.
Community Television Corp., New Orleans, La., channel 32.
Genesee Valley Television Co., Rochester, N. Y., channel 27.

Between the time that the FCC lifted its "freeze" on the construction of new television stations last year and the end of March 1953, construction permits were issued for 325 new outlets as show in the following tabulation.

STATE AND CITY	APPLICANT	CHANNEL
Alabama		
Birmingham	Birmingham News Co.	42
	Johnston BC Co.	48
Decatur	Tenn. Valley BC Co.	23
Gadsden	A. Newborn Jr.	21
Mobile	*Fursley BC Service	48
Montgomery	Capital BC Co.	20
Arkansas		
Fort Smith	Southwestern Publ. Co.	22
Little Rock	Great Plains TV Properties	23
	*Little Rock Telecasters	17
California		
Bakerfield	Bakersfield BC	29
Fresno	McClatchey BC Co.	24
Los Angeles	John Poole BC Co.	22
Salinas	Salinas-Monterey TV Co.	28
San Bernardino	KITO Inc.	18
San Francisco	L. A. Harvey	20
Stockton	San Joaquin Telecasters	36
Yuba City	John Steventon	52
Colorado		
Denver	Empire Coil Co.	26
	Mountain States TV Co.	20
Connecticut		
Bridgeport	*S. Conn. & Long Island TV Co.	43
	Harry L. Liftig	49
New Britain	*New Britain BC Co.	30
New London	Thames BC Corp.	26
Waterbury	WARR Inc.	53
Delaware		
Harrington (Dover)	Rollins BC Co.	40
Florida		
Fort Lauderdale	Gerico Investment Co.	17
	*Gore Publ. Co.	23
Lakeland	WONN-TV, Inc.	16
Pensacola	Southland Telecasters	15
St. Petersburg	*City of St. Petersburg	38
West Palm Beach	WIRK-TV Inc.	21
Georgia		
Columbus	Television Columbus	28
Macon	Macon TV Co.	47
Valdosta	WGOV-TV	37

(Continued on page 77A)

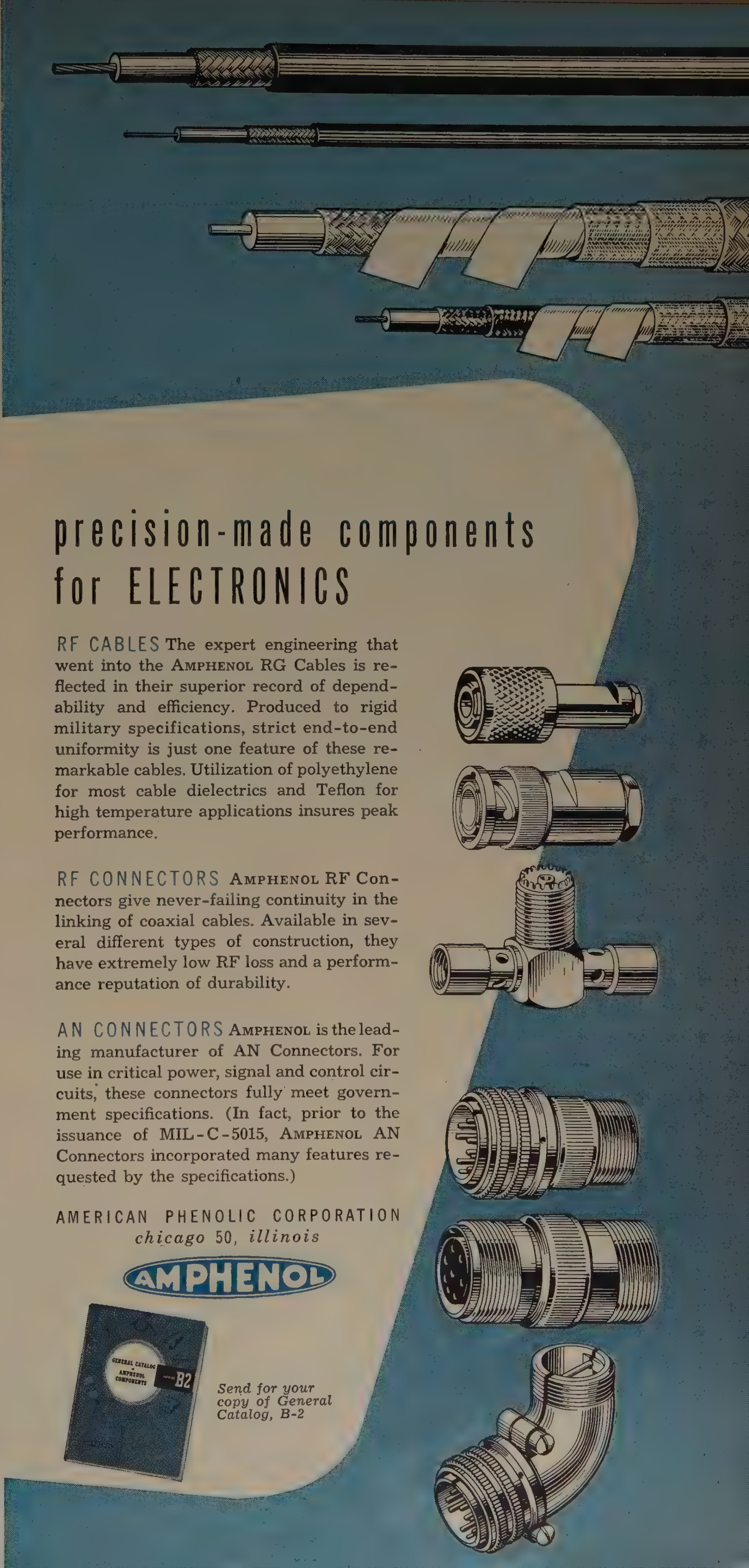
Industrial Engineering Notes

(Continued from page 76A)

State and City	Applicant	Channel
Illinois		
Belleville	Signal Hill Telecasting Co.	54
Bloomington	C. W. Roberts	15
Chicago	Johnson-Kennedy Radio Co.	20
	WHFC Inc.	26
Danville	Northwestern Publ. Co.	24
Decatur	Prairie TV Co.	17
Harrisburg	Turner-Farrar Assoc.	22
Peoria	Hilltop BC Co.	19
	*West Central BC Co.	43
Rockford	Winnebago TV Corp.	39
Springfield	Plains TV Co.	20
Indiana		
Indianapolis	Empire Coil Co.	67
	Marion Radio Corp.	26
Lafeyette	WFAM Inc.	59
Marion	Chronicle Publ. Co.	29
Muncie	Tri-City Radio Corp.	49
Princeton	Princeton BC Co.	52
South Bend	*South Bend Tribune	34
Iowa		
Davenport	M. Foster-H. Hoersch	36
Des Moines	Rib Mountain Radio Inc.	17
Fort Dodge	Northwest TV Co.	21
Sioux City	Great Plains TV Prod. Inc.	36
Kentucky		
Ashland	Polan Industries	59
Henderson	Ohio Valley TV Co.	50
Louisville	Mid-American BC Corp.	21
	R. W. Roundsaville	41
Kansas		
Wichita	The C. W. C. Co.	16
Louisiana		
Baton Rouge	Capital TV & BC Co.	40
	*Modern BC Co.	28
Lake Charles	Southland Telecasters	25
Monroe	Delta TV Inc.	43
New Orleans	New Orleans TV Co.	20
	Supreme BC Co.	61
Maine		
Portland	Portland Telecasting Corp.	53
Massachusetts		
Boston	E. Anthony & Sons	50
Cambridge	Middlesex BC Corp.	56
Fall River	N. E. TV Co.	46
New Bedford	E. Anthony & Sons	28
North Adams	Greylock BC Co.	74
Northampton	Regional TV Corp.	36
Springfield-Holyoke	Hampden-Hampshire Corp.	55
	Springfield TV BC Corp.	61
Maryland		
Baltimore	WITH-TV Inc.	60
Frederick	Monocacy BC Co.	62
Salisbury	Peninsula BC Co.	16
Michigan		
Ann Arbor	Washtenaw BC Co.	20
Battle Creek	Booth Radio & TV Stations Inc.	64
	Michigan BC Co.	58
Benton Harbor	Palladium Publ. Co.	42
Flint	Trans-American TV Corp.	28
	Trendell-Campbell BC Corp.	16
Jackson	WIBM Inc.	48
Kalamazoo	H. D. Steere	36
Lansing	Lansing BC Co.	54
Muskegon	Versluis Radio & TV Inc.	35
Saginaw	Lake Huron BC Corp.	57
Minnesota		
Duluth	Great Plains TV Prop. Inc.	38
St. Paul	WCOW Telecasting Co.	17
Mississippi		
Columbus	Birney Imes, Jr.	28
Gulfport	WGCM TV Corp.	56
Jackson	*Mississippi Publ. Corp.	25
Meridian	Mississippi BC Co.	30
Missouri		
Clayton	Lutheran Church, Missouri Synod	30
Festus	Ozark TV Corp.	14
Kansas City	Empire Coil Co.	25
St. Louis	Broadcast House, Inc.	36
	Missouri BC Corp.	42

* On the air or STA granted.

(Continued on page 78A)



precision-made components for ELECTRONICS

RF CABLES The expert engineering that went into the Amphenol RG Cables is reflected in their superior record of dependability and efficiency. Produced to rigid military specifications, strict end-to-end uniformity is just one feature of these remarkable cables. Utilization of polyethylene for most cable dielectrics and Teflon for high temperature applications insures peak performance.

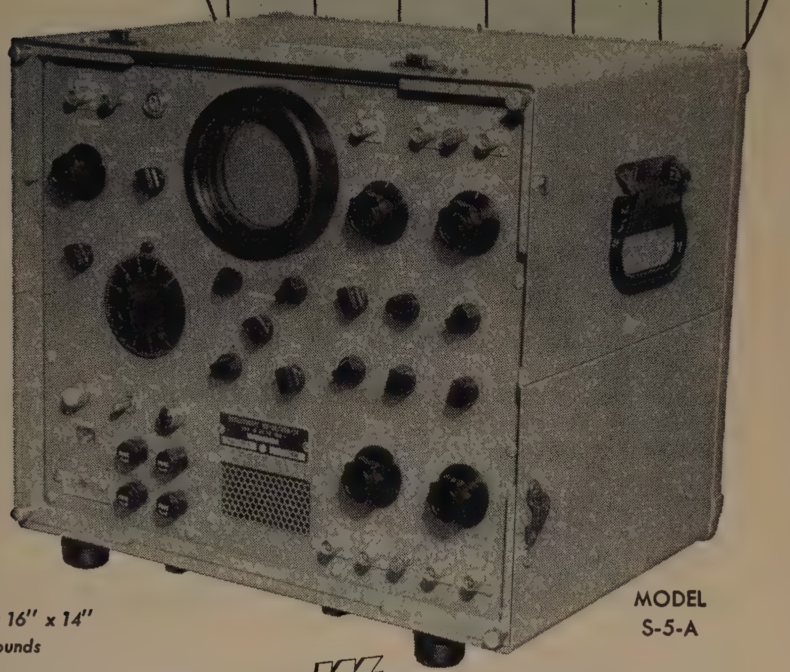
RF CONNECTORS Amphenol RF Connectors give never-failing continuity in the linking of coaxial cables. Available in several different types of construction, they have extremely low RF loss and a performance reputation of durability.

AN CONNECTORS Amphenol is the leading manufacturer of AN Connectors. For use in critical power, signal and control circuits, these connectors fully meet government specifications. (In fact, prior to the issuance of MIL-C-5015, Amphenol AN Connectors incorporated many features requested by the specifications.)

AMERICAN PHENOLIC CORPORATION
chicago 50, illinois

AMPHENOL

Send for your copy of General Catalog, B-2 the Waterman LAB PULSESCOPE®



Size:
13" x 16" x 14"
60 Pounds

MODEL
S-5-A

ANOTHER EXAMPLE OF Waterman PIONEERING...

The LAB PULSESCOPE, model S-5-A, is a compact, wide band laboratory oscilloscope for the study of all attributes of complex waveforms. The video amplifier response is up to 11 MC and provides an equivalent pulse rise time of 0.035 microseconds. Its 0.1 volt p to p/inch sensitivity and 0.55 microsecond fixed delay assure portrayal of the leading edge when the sweep is triggered by the displayed signal. An adjustable precision calibration voltage is incorporated. The sweep may be operated in either triggered or repetitive modes from 1.2 to 12,000 microseconds. Optional sweep expansion of 10 to 1 and built-in markers of 0.2, 1, 10, 100, and 500 microseconds, which are automatically synchronized with the sweep, extend time interpretations to a new dimension. Either polarity of the internally generated trigger voltage is available for synchronizing any associated test apparatus. Operation from 50 to 1000 c.p.s. at 115 volts widens the field application of the unit. These and countless additional features of the LAB PULSESCOPE make it a MUST for every electronic laboratory.

WATERMAN PRODUCTS CO., INC.
PHILADELPHIA 25, PA.
CABLE ADDRESS: POKETSCOPE

MEMO...
Write for details today!

WATERMAN PRODUCTS INCLUDE
S-4-A SAR PULSESCOPE
S-11-A INDUSTRIAL POCKETSCOPE®
S-12-B JANized RAKSCOPE®
S-14-A HIGH GAIN POCKETSCOPE
S-14-B WIDE BAND POCKETSCOPE
S-15-A TWIN TUBE POCKETSCOPE

WATERMAN PRODUCTS

Also RAYONIC® Cathode Ray Tubes and Other Associated Equipment

Industrial Engineering Notes

(Continued from page 77A)

State and City	Applicant	Channel
North Carolina		
Asheville	*Radio Station WISE Inc.	62
Charlotte	Inter-City Advertising Co. of Charlotte NC	36
Durham	T. E. Allen & Sons Inc.	46
Greensboro	Inter-City Advertising Co. of Greensboro NC	57
Hendersonville	Radio Hendersonville Inc.	27
Mount Airy	R. D. Epperson	55
Raleigh	Sir Walter TV & BC Co.	28
Winston-Salem	Winston-Salem BC Co.	26
Asbury Park	Atlantic Video Corp.	58
Atlantic City	Matta Enterprises	52
	*Neptune BC Corp.	46
New York		
Buffalo	Buffalo-Niagara TV Corp.	59
	Chautauqua BC Corp.	17
Elmira	El-Cor TV Inc.	18
	Elmira TV	24
Ithaca	Cornell University	20
Jamestown	James Broadcasting Co.	58
Kingston	Kingston BC Corp.	66
Poughkeepsie	Mid-Hudson BC Inc.	21
Watertown	Brockway Co.	48
Ohio		
Akron	Summitt Radio Corp.	49
Ashtabula	WICA, Inc.	15
Dayton	Skyland BC Corp.	22
Lima	Northwestern Ohio BC Corp.	35
	WLOK Inc.	73
	(STA granted 3/20/53)	
Massillon	Midwest TV Co.	23
Sandusky	Lake Erie BC Co.	42
Warren	Warren Tribune Radio Station Inc.	67
Youngstown	Poland Industries	21
	*Vindicator Printing Co.	73
	*WKBN BC Corp.	27
Zanesville	Southeastern Ohio TV System	50
Oklahoma		
Oklahoma City	KLPR TV Inc.	19
	Oklahoma County TV & BC	25
Tulsa	Elfred Beck	23
Oregon		
Eugene	W. G. Allen	20
Portland	*Empire Coil Co.	27
Salem	L. A. Harvey	23
Pennsylvania		
Bethlehem	Assoc. Broadcasters Inc.	51
Chambersburg	Chambersburg BC Co.	46
Easton	Easton Publ. Co.	57
Harrisburg	Harrisburg BC Inc.	71
	*WHP Inc.	55
Hazelton	Hazelton BC Co.	63
Johnstown	Rivoli Realty Co.	56
New Castle	*WKST Inc.	45
Philadelphia	Pennsylvania BC Co.	29
Pittsburgh	*A. J. Reeves Greer	53
	J. Gallaher, Loren Berry & R. B. Woodyard, a partnership	47
	Telecasting Co. of Pittsburgh	16
Reading	*Eastern Radio Corp.	61
	*Hawley BC Co.	33
Scranton	Appalachian Co.	73
	Scranton Broadcasters Inc.	22
	Union BC Co.	16
Wilkes-Barre	*L. G. Baltimore	28
	Wyoming Valley BC Co.	34
Williamsport	WRAK Inc.	36
York	Helm Coal Co.	49
	Susquehanna BC Co.	43
South Carolina		
Columbia	Palmetto Radio Corp.	67
	Radio Columbia	25
Greenville	Greenville TV Co.	23
Tennessee		
Chattanooga	Chattanooga TV Inc.	49
	Tom Potter	43
Knoxville	TV Services of Knoxville	26
Austin	Capital City BC Co.	18
	Tom Potter	24
Texas		
Beaumont	TV Broadcasters	31
Dallas	Trinity BC Corp.	29
	UHF TV Co.	23
Fort Worth	Tarrant County TV Co.	20
Galveston	Rudman TV Co.	41
Houston	KNUZ TV Co.	39

(Continued on page 80A)

RMC By-Pass DISCAPS

are Rated at 1000 Working Volts

Modern Engineering Requires This
"HEAVY DUTY" CERAMIC CAPACITOR

The heavier ceramic dielectric element made by an *entirely new process* provides the necessary safety factor required for line to ground applications or any application where a steady high voltage condition may occur. Designed to withstand constant 1000 V.A.C. service.

It is wise to specify RMC "HEAVY DUTY" by-pass DISCAPS throughout the entire chassis because they *cost no more* than ordinary lighter constructed units.

Specify them too, for your own peace of mind, with the knowledge that they can "take it." And if you want proof—request samples.

"RMC DISCAPS"
The Right Way to Say
Ceramic Condensers

A New Development from the RMC Technical Ceramic Laboratories

DISCAP
CERAMIC
ONDENSERS

RMC

RADIO MATERIALS CORPORATION
GENERAL OFFICE: 3325 N. California Ave., Chicago 18, Ill.
FACTORIES AT CHICAGO, ILL. AND ATTICA, IND.
DISTRIBUTORS: Contact Jobber Sales Co., 146 Broadway, Paterson 1, N. J.

MODEL SB-8a

Type T-10,000

PANORAMIC PANALYZOR

Panoramic's simple "add 30 MC" formula illustrated in the diagrams above provides economy through versatility. This important advantage meets the need for a single low cost, high grade spectrum analyzor usable on many bands . . . UHF, VHF, and microwave. First cost economy is achieved since the SB-8a is a basic foundation spectrum analyzer which simply requires a signal generator to convert the test signal to the input frequency of the Panalyzor! Conversion is effected within the equipment. External mixers are recommended for microwave conversions.

APPLICATIONS: The Panalyzor is designed for application of research level yet it is so simple to operate that it is used extensively for production testing . . . analysis of pulse RF signals, output of magnetrons, klystrons, and other radar gear, FM signals and noise modulated carriers . . . detection of spurious oscillator and modulator . . . frequency measurement . . . radar gear adjustment.

Unique SB-8a Features Assure Peak Efficiency

● variable bandwidth IF section accommodates a range of pulse widths, prevents masking of nulls in spectrum distribution ● 10 mc. scanning width continuously reducible to approximately 0 mc ● selectable scanning rates 1 cps, 5 cps, 30 cps, 25-35 cps variable ● 5" long persistence C-R tube.

Write today for complete information, prices and delivery.

PANORAMIC
RADIO PRODUCTS, INC.

12 South Second Ave., Mount Vernon, N.Y.
MOunt Vernon 4-3970

Industrial Engineering Notes

(*Continued from page 78A*)

STATE AND CITY	APPLICANT	CHAN
	UHF TV Inc.	23
Longview	East Texas TV Co.	32
McAllen	Texas State Network Inc.	20
San Antonio	Alamo TV Co.	35
Sherman	Sherman TV Co.	46
Tyler	J. A. Newborn, Jr.	19
Victoria	KNAL TV Co.	19
Waco	Central Texas TV Co.	24
Wichita Falls	White TV Co.	22
Virginia		
Charlottesville	Barham & Barham	64
Danville	Piedmont BC Corp.	24
Hampton	Peninsula BC Corp.	15
Lynchburg	Old Dominion BC Corp.	16
Newport News	Eastern BC Corp.	33
Roanoke	*Radio Roanoke Inc.	27
Washington		
Yakima	Cascade BC Co.	29
	KIT Inc.	23
West Virginia		
Charleston	J. L. Smith, Jr., Inc.	49
Parkersburg	West Virginia Enterprises, Inc.	15
Wheeling	Polan Industries	51
Wisconsin		
Beloit	Beloit BC Co.	57
Madison	Bartell TV Corp.	33
	Monona BC Co.	27
Milwaukee	Midwest BC Co.	25
Neenah	Neenah-Menasha BC Co.	42
Oshkosh	Oshkosh BC Co.	48

EDUCATIONAL UHF STATIONS

California		
Los Angeles	Univ of South Calif.	28
Connecticut		
Bridgeport	Conn. State Board of Education	71
Hartford	Conn. State Board of Education	24
Norwich	Conn. State Board of Education	63
Michigan		
East Lansing	Mich. State Board of Agriculture	60
New Jersey		
New Brunswick	Dept. of Education, State of N. J	19
New York		
Albany	Univ. of the State of N. Y.	17
Binghamton	Univ. of the State of N. Y.	46
Buffalo	Univ. of the State of N. Y.	23
Ithaca	Univ. of the State of N. Y.	14
New York	Univ. of the State of N. Y.	25
Rochester	Univ. of the State of N. Y.	21
Syracuse	Univ. of the State of N. Y.	43

COMMERCIAL VHF STATIONS

Alabama		
Mobile	*Pape BC Co.	10
Arizona		
Mesa	Harkins BC Inc.	12
Tucson	Arizona BC Corp.	4
	*Old Pueblo BC Co.	13
	Catalina BC Co.	9
Yuma	Valley Telecasting Co.	11
California		
Chico	Golden Empire BC Co.	12
Eureka	Redwood BC Co.	3
Salinas	Share-time grant to Salinas BC Corp. and Monterey Radio-TV-Co.	8
San Diego	Airfan Radio Corp. Ltd.	10
San Luis Obispo	Valley Electric Co.	6
Santa Barbara	Santa Barbara BC & TV	3
Colorado		
Colorado Springs	Pikes Peak BC Co.	13
	*TV Colorado Inc.	11
Grand Junction	Western Slope BC Co.	5
Denver	*E. P. O'Fallon	2
	*Colorado TV Corp.	9
Pueblo	Pueblo Radio Co.	3
	Star Broadcasting Co.	5

* On the air or STA granted.

(*Continued on page 82A*)

Your best buy is E-I — for every SEALED TERMINAL REQUIREMENT!

E-I Compression Type Headers

A new series of super-rugged, practically indestructible headers made by an exclusive E-I process. Feature non-flexing solid metal blanks — no stampings. Many standard types available. Silicone treated and tin-dipped.

For details, request
BULLETIN 960

E-I Hermetically Sealed Terminals

A complete line of standard terminals that fill practically any need with mass production economy. Strain-free glass for highest thermal and mechanical shock resistance.

For details, request
BULLETIN 949-A

E-I GS Series Multiple Headers

Includes a wide assortment of standardized headers featuring a single overall glass insert for longer leakage paths and to permit closer spacing of terminals. Most of these can be furnished with exhaust tube. All are silicone treated and tin-dipped.

For details, request
BULLETIN [illegible]

E-I Color Coded Terminals

Supplied with glass inserts colored in RMA code colors. Coloring is in the glass. No surface coatings of color to fade or impair insulating qualities.

For details, request
BULLETIN [illegible]

E-I Tubular End Seals

The ideal end closures for resistors, capacitors and other tubular components. All commonly used sizes and types are available as standard stock items for maximum economy.

For details, request
BULLETIN 952

STANDARD TYPES — Available from stock, E-I standard sealed terminals offer a ready solution to problems involving hermetic sealing. Hundreds of types, with many optional features, include sealed leads, multiple headers, octal plug-ins, tubular end seals and color-coded terminals. SPECIAL TYPES — for applications requiring special designs, custom types can be supplied to specification at prices reflecting mass production economies. Recommendations will be made promptly on receipt of your requirements.

E-I . . . your headquarters for hermetically-sealed terminations of every type. Over 10 years of specialized experience insures highest quality at lowest cost.

DIVISION OF AMPEREX ELECTRONIC CORP.

E I

ELECTRICAL INDUSTRIES
44 SUMMER AVENUE, NEWARK 4, NEW JERSEY
EXPORT AGENTS:
PHILIPS EXPORT CORP., 100 EAST 42nd STREET, NEW YORK 17, N. Y.

SUB-MINIATURE
PILOT LIGHTS
Approved for AIRCRAFT
AND IMPROVED IN IMPORTANT DETAILS

DIALCO

SUB-MINIATURE INDICATOR ASSEMBLIES
A great aid to your miniaturization program

MOUNT IN 15/32" HOLE
ALL LENS COLORS
Easy lamp replacement with any midget flanged base lamp types
Complete blackout or semi-blackout dimmer types

ACTUAL SIZE
NON-DIMMING
No. 8-1930-621

ACTUAL SIZE
MECHANICAL DIMMER
No. 11-1930-621

THESE ASSEMBLIES LOGICALLY REPLACE LAMPS NO. 319, 320, and 321

REPLACE WITH THIS — NOT THIS — OR THIS

PLASTIC PLATE (EDGE) LIGHT ASSEMBLIES
AIR FORCE and BUREAU of AERONAUTICS
MIL-L-7806 DRAWING MS-25010
DIALCO *No. TT-51* (Red filter-black top)
. . . or, *No. TT-51A*, complete with No. 327 Lamp

ALSO MADE
with other filter colors and with *light-emitting* top (for indication)

ACTUAL SIZE

ALL OF THE ASSEMBLIES ILLUSTRATED ACCOMMODATE LAMPS NOS. 327, 328, 330, and 331.
ANY ASSEMBLY AVAILABLE COMPLETE WITH LAMP
SAMPLES ON REQUEST—NO CHARGE

Foremost Manufacturer of Pilot Lights
DIALIGHT CORPORATION
60 STEWART AVENUE, BROOKLYN 37, N. Y. HYACINTH 7-7600
© 1952

Industrial Engineering Notes

(*Continued from page 80A*)

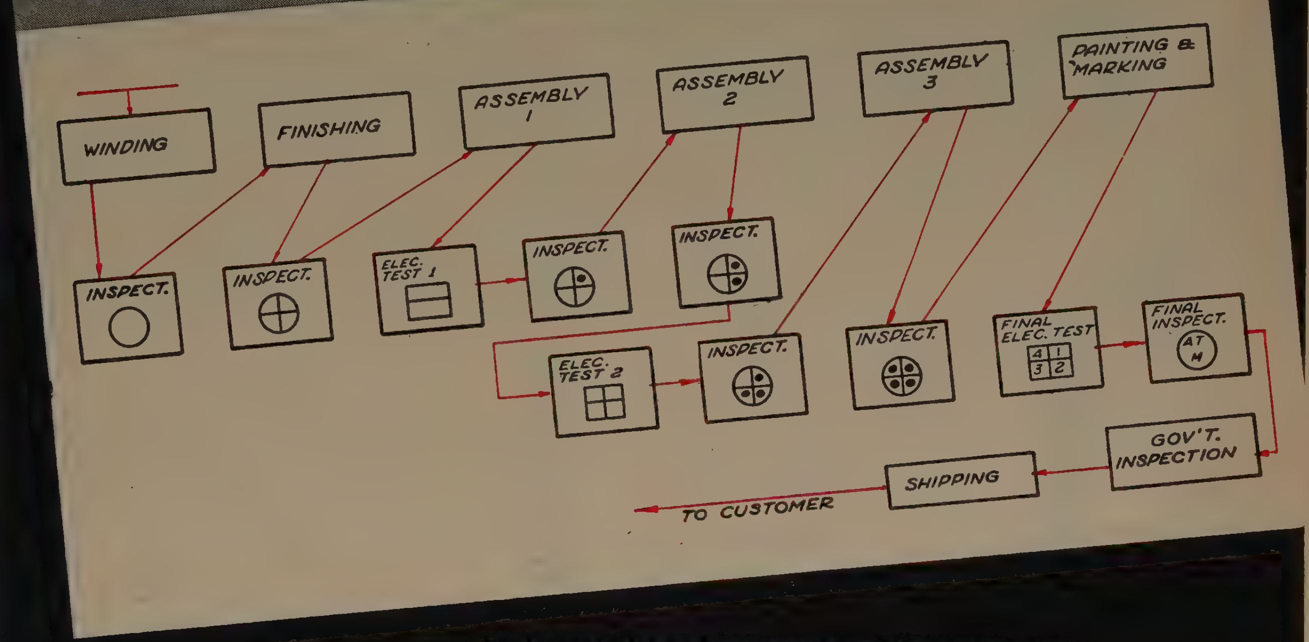
STATE AND CITY	APPLICANT	CHAN
Florida		
Fort Myers	Fort Myers BC Co.	11
Panama City	J. D. Manly	7
Georgia		
Rome	Coosa Valley Radio Co.	9
Warner-Robins	Southeastern BC Co.	13
Idaho		
Boise	Idaho BC & TV Co.	9
	KIDO Inc.	7
Idaho Falls	Idaho Falls TV Inc.	8
	Idaho Radio Corp.	3
Nampa	Frank E. Hurt & Sons Inc.	6
Pocatello	Eastern Idaho BC & TV Co.	10
	Tribune-Journal Co.	6
Twin Falls	Southern Idaho BC & TV Co.	11
Illinois		
Champaign	Midwest TV Inc.	3
Iowa		
Sioux City	*Cowles BC Co.	9
Kansas		
Hutchinson	Hutchinson TV Inc.	12
Pittsburg	Pittsburg BC Co.	7
Louisiana		
Monroe	J. A. Noe	8
Maine		
Bangor	*Community Telecasting Service	
Minnesota		
Austin	Minnesota-Iowa TV Co.	6
Rochester	Southern Minnesota BC Co.	10
St. Cloud	Granite City BC Co.	7
Missouri		
Columbia	Curators of the Univ. of Mo.	8
Hanibal	Courier-Post Publ. Co.	7
Sedalia	*Independent BC Co.	6
Springfield	Springfield TV Inc.	3
St. Joseph	KFEQ Inc.	2
Montana		
Billings	Montana Network	2
Billings	Rudman-Hayutin TV Co.	8
Butte	Copper Broadcasting Co.	4
	Television Montana	6
Great Falls	Buttrey BC Inc.	5
Missoula	Mosby's Inc.	13
Nebraska		
Lincoln	Cornbelt BC Corp.	10
	*Cornhusker Radio & TV Corp.	12
Nevada		
Las Vegas	Las Vegas TV Inc.	8
Reno	Nevada Radio-TV Inc.	8
North Carolina		
Greenville	Carolina BC System	9
North Dakota		
Bismark	Meyer Broadcasting Co.	5
	Rudman TV Co.	12
Fargo	WDAY Inc.	6
Minot	*North Dakota BC Co.	13
	Rudman TV Co.	10
New Mexico		
Albuquerque	New Mexico BC Co.	13
Clovis	Telepolitan BC Co.	12
Roswell	J. A. Barnett	8
Santa Fe	Greer and Greer	2
New York		
Rochester	Share-time grant to Veterans BC Co. and WHEC Inc.	10
Oklahoma		
Lawton	*Oklahoma Quality BC Co.	7
Oregon		
Medford	Southern Quality BC Co.	5
Pennsylvania		
Altoona	*Gable BC Co.	10

* On the air or STA granted.

(*Continued on page 84A*)

Quality First

Your Transformer Has To Pass These 10 Inspections



Equipment pictured are samples of the various types of transformers manufactured by Aircraft Transformer Corporation, originators of the famed FORM*FLEX*

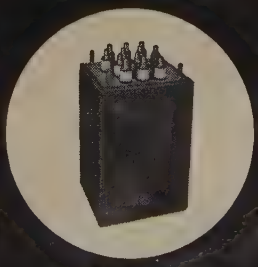
AIRCRAFT TRANSFORMER CORPORATION

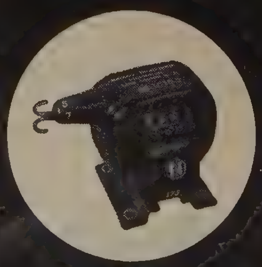
MANUFACTURERS OF INDUCTIVE EQUIPMENT • LONG BRANCH, NEW JERSEY. LONG BRANCH 6-6250

Plate and Filament

Blocking Oscillator

Audio


Filament


Pulse

Representatives now located in principal cities throughout the country. Write for address of the one nearest you.

For the first time

FLEXIBLE WAVEGUIDE *with power rating equal to that of rigid guide!*

BANK ON Airtron inc. for

HIGH POWERED FLEXAGUIDE®

for RADAR applications

Broad-band FLEXIBLE assemblies guaranteed to a V.S.W.R. of less than 1.10—attenuation equal to that of brass rigid waveguide—yet none of the essential advantages of flexible plumbing sacrificed to achieve this new type of waveguide! Performance is what counts; let us show you . . .

NOW you can route your R.F. circuits into previously impossible channels, without power, V.S.W.R. or attenuation penalties

Write for data sheets on new, high powered FLEXAGUIDE

PEAK POWER AT BREAKDOWN MEGAWATTS
1.5
1.4
1.3
1.2
1.1
1.0
RIGID RG-52/U
PULSE WIDTH - 2.5 μ SEC.
PRF - 360 PULSES PER SEC.
EXTERNAL RADIATION Co^{60}
AIRTRON FLEXAGUIDE AHR-116
1 2 3 4 5 6 7 8 9 10
TEST RUN NUMBERS

Airtron inc.
20 East Elizabeth Ave., Linden, New Jersey

BRANCH OFFICES
CHICAGO ST. LOUIS DAYTON DALLAS
BALTIMORE LOS ANGELES SEATTLE

Industrial Engineering Notes

(Continued from page 82A)

STATE AND CITY	APPLICANT	CHANNEL
Puerto Rico		
San Juan	El Mundo BC Corp.	2
South Carolina		
Charleston	WCBC Inc.	5
Columbia	WIS-TV Corp.	10
South Dakota		
Sioux Falls	Midcontinent BC Co.	11
Tennessee		
Johnson City	WJHL Inc.	11
Memphis	Harding College	13
Texas		
Amarillo	*Amarillo BC Co.	10
	*Plains Radio BC Co.	4
Austin	*Texas BC Corp.	7
El Paso	KEPO Inc.	13
	*Roderick BC Corp.	4
	*Tri-State BC Co.	9
Galveston	*Gulf TV Co.	11
Lubbock	Bryant Radio & TV Inc.	11
	*Texas Telecasting Inc.	13
Lufkin	Forest Capital BC Co.	9
Midland	Permian Basin TV Co.	2
San Angelo	KGKL Inc.	3
	Westex TV Co.	8
Temple	Bell Publ. Co.	6
Texarkana	KCMC, Inc.	6
Wichita Falls	*Wichita Falls TV Inc.	6
	Wichtex Radio & TV Co.	3
Hawaii		
Honolulu	*Hawaiian BC System Ltd.	9
	*Radio Honolulu Ltd.	11
Utah		
Salt Lake City	Utah BC & TV Corp.	2
Virginia		
Harrisonburg	Shenandoah Valley BC Corp.	3
Lynchburg	*Lynchburg BC Corp.	13
Roanoke	*Roanoke BC Corp.	10
Washington		
Bellingham	KVOS Inc.	12
Spokane	*Symons BC Co.	4
	*KHQ	6
Tacoma	KMO Inc.	13
	*Tribune Publ. Co.	11
Wisconsin		
Eau Claire	Central BC Co.	13
Green Bay	*Norbertine Fathers	2
Wyoming		
Cheyenne	Frontier BC Co.	5
	EDUCATIONAL VHF STATIONS	
Kansas		
Manhattan	Kansas State College of Agric. & Appl. Sci.	8
Texas		
Houston	Univ. of Houston and Houston Independent School District	8

* On the air or STA granted.

Coming

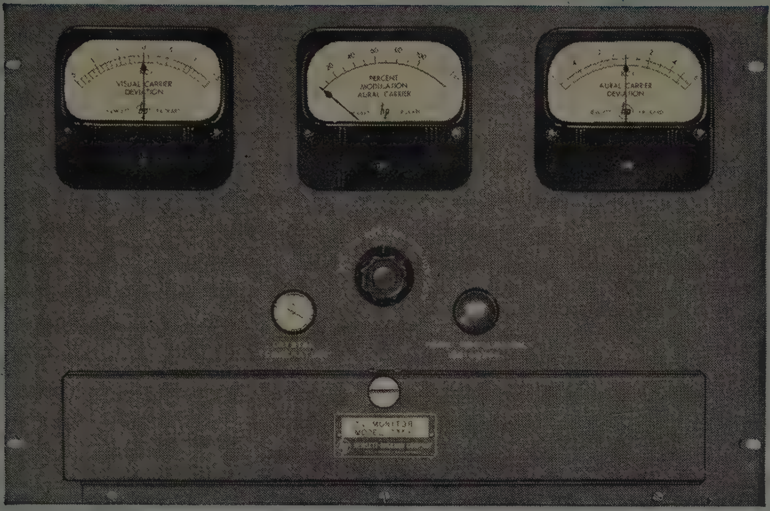
1953

IRE DIRECTORY

ABOUT

SEPTEMBER 15

ELECTRONIC TEST INSTRUMENTS



TV MONITOR

MODEL 335E

All channels 2 to 83

Exceeds F. C. C. requirements

12¼" high; rack mounted

High stability, accuracy, long-term dependability

Monitors visual, aural frequencies; percentage aural modulation

New! Small, low-cost monitor for all TV channels gives continuous, precise indication without adjustment

The unusually compact, low-cost Model 335E occupies just 12¼" of a standard relay rack. Yet it accurately and continuously performs all VHF and UHF television monitoring functions including visual and aural carrier frequency and aural carrier percentage modulation measurement.

Carefully engineered crystal reference oscillators provide accuracy in excess of F. C. C. requirements for all channels. Because discriminator accuracy does not depend on a tuned circuit, no time-consuming adjustments are required during operation. It is never necessary to reset carrier level or realign circuits. Proper operation of the monitor can be checked conveniently by controls located behind the front panel cover.

Trouble-Free Dependability

The monitor is specifically designed to operate at full accuracy over long periods of time without maintenance. Highest quality components and construction are used throughout. A new chassis design increases accessibility of components and makes possible cool operation through forced ventilation. Extra features include provision for remote indicating meters, remote peak modulation indicator lamp, and a demodulated signal for aural monitoring.

The instrument also includes a front-panel crystal temperature indicator and illuminated meter faces. It fits a standard relay rack, and can be color finished to match your transmitter installation.

SPECIFICATIONS

AURAL FREQUENCY MONITOR

Deviation Meter Range: +6 kc to −6 kc.

Accuracy: Better than ±1,000 cps for at least 10 days.

AURAL MODULATION METER

Modulation Range: Meter reads full scale on 33.3 kc swing. Calibrated to 100% at 25 kc swing; 133% at 33.3 kc swing.

Accuracy: Within 5% of mod. full scale.

Meter Characteristics: Meter damped in accordance F.C.C. requirements. Reads peak value of modulation peak of duration between 40 and 90 milliseconds. Meter returns from full reading to 10% of full value within 500 to 800 msec.

Frequency Response: Flat within ±½ db, 50 to 15,000 cps.

MODULATION PEAK INDICATOR

Peak Flash Range: From 50% to 120% modulation (25 kc = 100%).

VIDEO FREQUENCY MONITOR

Deviation Meter Range: +1.5 to −1.5 kc.

Accuracy: Better than ±500 cps for at least 10 days.

AUDIO OUTPUT

Frequency Range: 50 to 15,000 cps. Response flat within ± ½ db. Standard 75 µsec de-emphasis circuit.

Distortion: Less than 0.25% at 100% modulation.

Output Voltage: 10 volts into 20,000 ohms at 100% modulation (low frequencies).

Monitoring Output: 1 milliwatt into 600 ohms, balanced, at 100% modulation (low frequencies).

Residual Noise: At least 70 db below output level corresponding to 100% modulation (low frequencies).

GENERAL

Frequency Range: Channels 2 to 83 inclusive, including offset channels.

R. F. Power Required: Approx. 1 watt.

External Meter Indication: Available for aural carrier deviation, video carrier deviation, aural modulation percentage and peak indication.

Size: 12¼" x 19" x 13". Rack mounting.

Power: 115 volts, 50/60 cps, 180 watts.

Price: $1,950.00 f.o.b. factory.

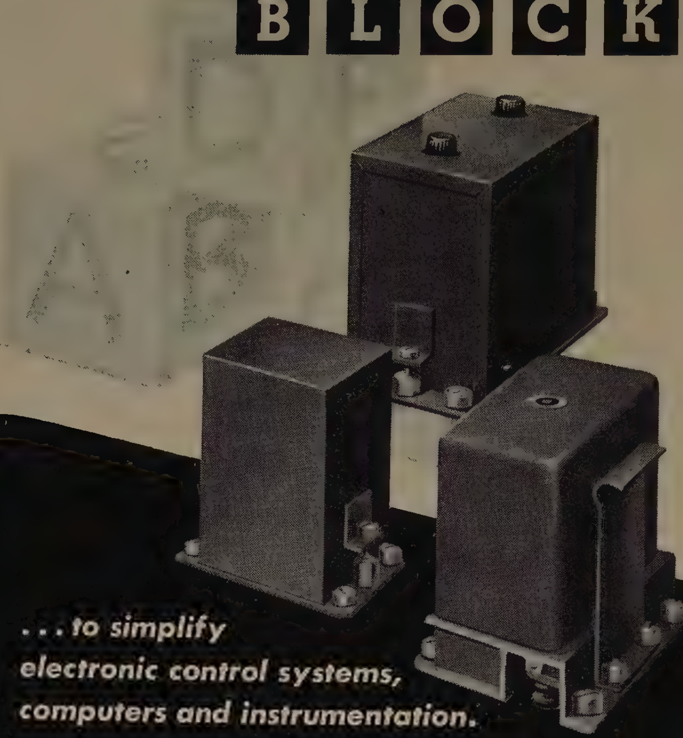
Data subject to change without notice

HEWLETT-PACKARD CO.
27571 Page Mill Road, Palo Alto, California, U. S. A.
SALES AND ENGINEERING REPRESENTATIVES IN PRINCIPAL CITIES

Copyright 1953 Hewlett-Packard Co.

Instruments for Complete Coverage

Electronic
BUILDING BLOCKS



. . . to simplify electronic control systems, computers and instrumentation.

Servomechanisms, Inc. "building block" or packaged function technique reduces intricate "all in one" systems into simple, standard electronic components which plug into pre-wired chassis. This advanced design philosophy provides **reliability, interchangeability, and ease of maintenance.** The same concept has been applied to Servomechanisms, Inc. expanding line of transducers.

Universally accepted and proven in combat these "building blocks" are available for 60 and 400 cycle applications . . . Write to Dept. CLO-4 for complete information.

A typical Servomechanisms, Inc. analog computer and transducer for aircraft instrumentation.

SERVOMECHANISMS INC.

Westbury Division
Post and Stewart Aves., Westbury, N. Y.

El Segundo Division
316 Washington St., El Segundo, Calif.

POSITIONING MECHANISMS • SERVO AMPLIFIERS • MODULATORS • POWER SUPPLIES
SERVO MOTORS • ADAPTERS • TRANSDUCERS • MECHANICAL DEVELOPMENT APPARATUS

SECTION MEETINGS

AKRON

"The 'Auto-Sembly' Process for Printed C cuits," by S. J. Lanzalotti, Squier Signal Co Labs., Fort Monmouth; March 17, 1953.

ATLANTA

"Development and Application of the Tra sistor," by D. K. Smith, Bell Telephone Labs.; Fe ruary 20, 1953.

"The Air Material Command's Vacuum Tu Reliability Program," by Col. B. K. Boettche Wright Patterson Air Force Base; March 20, 195

"Shooting Live Television Shows on Film," Carl Freund, A.S.C.; "Film-Craft's Camera Co trol System," by Ferenz Fodor, Film-Craft; "Ma netic Sound Tracks for Processed 16 mm. Motic Picture Film," prepared by Thomas Dedell an read by E. M. Stifle, both of Eastman Kodak Co April 2, 1953.

BALTIMORE

"Dielectric Amplifiers," by G. W. Penney, Ca negie Institute of Technology; April 8, 1953.

BEAUMONT-PT. ARTHUR

"TV Circuits and Trouble Shooting," by Fran Hadrick, Admiral Radio Corporation; March 1 1953.

"Seismic Prospecting and Instruments," b A. C. Winterhalter and J. W. Millington, Sun O Company; March 12, 1953.

"Practical Analysis of Modern TV Circuits," b R. G. Middleton, Precision Apparatus Company April 1, 1953.

"Propagation and Related Systems Problems i Two Way Radio," by J. A. McCormick, Genera Electric Company; April 6, 1953.

BOSTON

"Stability of Servomechanisms," by P. E. Le Corbeiller, Faculty, Harvard University; "Backlash in a Velocity Lag Servomechanisms," by N. B Nichols, Raytheon Manufacturing Co.; February 19, 1953.

BUFFALO-NIAGARA

"Binaural Sound: A Progress Report and Demonstration," by Norman Jarosik, Sylvania Electri Products Inc.; March 18, 1953.

CHICAGO

"The Engineer's place in the Atomic Energy Program," by Dr. R. F. Humphries, Armour Research Foundation; March 27, 1953.

DAYTON

"Future Trends in Electronics," by J. D. Ryder, Faculty, University of Illinois; April 9, 1953.

DENVER

"Transistors, the Latest Marvel of Electronics How They Work and What We Can Do with Them by T. R. Finch, Bell Telephone Laboratories; March 20, 1953.

DES MOINES-AMES

"Application of Transistors," by T. R. Finch Bell Telephone Laboratories; March 9, 1953.

DETROIT

"Rocket Borne Electronic Devices in Upper Atmosphere Research," by N. W. Spencer, University of Michigan; March 20, 1953.

FORT WAYNE

"Electronic Musical Instrument," by John Jordan; April 2, 1953.

HAMILTON

"Quartz Crystal Manufacture," by David Ei sen, Rogers Majestic Electronics Ltd.; March 16 1953.

"Low Noise Input Circuits," by A. C. Hudson National Research Council; April 13, 1953.

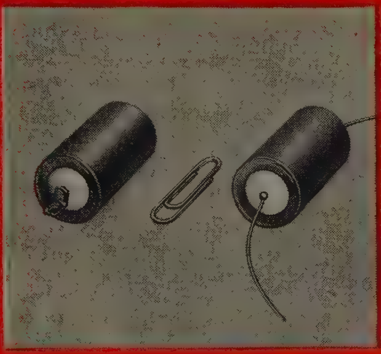
(Continued on page 88A)

LFE SOLID DELAY LINES STOP TIME!

WIDE RANGES OF DELAY
LOW ATTENUATION
LOW SPURIOUS RESPONSE
WIDE BANDWIDTH
SMOOTH PASS BAND
WIDE TEMPERATURE RANGE
MINIMUM SIZE AND WEIGHT
RUGGED CONSTRUCTION

Now available for applications such as video integration, computers, time markers, moving target indication.

LFE solid ultrasonic delay lines utilize fused quartz as the delay medium and offer many advantages in obtaining precise delay intervals for pulse or modulated signals:



PRECISION RANGE MARKER DELAY LINE

TYPICAL DELAY LINE SPECIFICATIONS FOR PRECISION 1,000 YDS. RANGE MARKER

Delay Time	3.050 ± 0.003 microseconds at 50° C. 3.05 μsec ± 0.02 over a temperature range 0° C. to 100° C.
Attenuation of first pulse	28 db. into 1,000 ohms
Center Frequency	30 Mc.
Bandwidth	7 Mc.
Capacity	15 to 20 mmfds.
Pulse decay	1 to 1½ db. average

This item available from stock

TYPICAL SOLID DELAY LINE

RANGE OF SOLID DELAY LINE SPECIFICATIONS

Delay Time	1-3,000 microseconds can be provided with a high degree of accuracy.
Frequency Range	5-100 Mc.
Spurious Response	Up to 60 db. below desired signal.

For further information, write: SPECIALTIES DIVISION

LABORATORY for ELECTRONICS, INC.
75-4 PITTS STREET • BOSTON 14, MASS.

PRECISION ELECTRONIC EQUIPMENT • OSCILLOSCOPES • MAGNETOMETERS • COMPUTERS • MICROWAVE OSCILLATORS • SOLID DELAY LINES

MODEL 201
Hysteresis Type
Synchronous Drive Motor

MODEL 228
Induction Drive Motor

MODEL 300
Reluctance Type
Synchronous Drive Motor

MODEL 168
Propeller Fan

MODEL 182A
Axial Flow Fan

MODEL 219
Single Ended
Motor-Blower

MODEL 220
Double Ended
Motor-Blower

Manufacturers also of HIGH FREQUENCY POWER SUPPLIES Inductor-Alternator type, 500 Watts to 75 KVA output. Portable, Semi-Portable and Stationary Types.

What makes GOOD Miniature Motor Design?

AMERICAN ELECTRIC's answer is the ultimate utilization of all available magnetic materials to convert electric input to maximum power output!

This is possible not only by proper choice of material and precision craftsmanship, but *by individually designing the laminations for the conditions of operation and the specific job to be done!* As a result, AMERICAN ELECTRIC has now developed tooling for almost any conceivable miniature requirement in both production and prototype models.

AMERICAN ELECTRIC Miniatures are noted for their high power-to-weight ratio; furnish compact means for driving airborne and ground equipment, such as *cams, clutches, timing devices, antennas, actuators, optical equipment, fans, blowers, recording devices, etc.*

Quiet, light in weight, extremely rugged and reliable. Specify AMERICAN ELECTRIC! Recommendations gladly given. Write, wire or phone requirement details.

TWO MINIATURE DRIVE MOTOR TYPES

Available for 60, 400 or 2000 c.p.s. operation, and variable frequencies from 320 to 1200 c.p.s. single or polyphase.

Induction Motors—Output torque range: ½ in. oz. to 120 in. oz.

Synchronous Motors—Output torque range: .01 in. oz. to 10 in. oz. in both Hysteresis and Reluctance types.

TWO MINIATURE COOLING TYPES

Centrifugal Blowers
Propeller Fans

AMERICAN ELECTRIC MOTORS
TRADE MARK

4811 Telegraph Road,
Los Angeles 22,
California

Engineering Representatives: TRAVCO ENGINEERING CO.
Silver Spring (Md.), Chicago, New York, Los Angeles

SECTION MEETINGS

(*Continued from page 86A*)

HAWAII

"Communication Networks in UHF and Other Systems Employed by the Arabian American Oil Company," by J. W. Teeuw, Federal Electric Company; January 14, 1953.

"TV in Hawaii," by R. W. Clark, KONA-TV; February 11, 1953.

"Digital Computers," by J. P. Erdman, IBM; March 11, 1953.

INYOKERN

"Range Computer Circuitry for the ARO Radar APG-39," by B. H. Wolf, Stavid Engineering, Inc.; April 14, 1953.

LITTLE ROCK

"Electronics in Nuclear Measurements," by P. E. Damon, Faculty, University of Arkansas; April 14, 1953.

LONDON

The Operation of the Approvals Laboratories of the Canadian Standards Association," by G. King, Professional Engineer; March 31, 1953.

LOS ANGELES

"Some Early Electrical Concepts and Methods," by Dr. D. Roller, Hughes Aircraft Company; and "A Design Procedure for Subminiature Electronic Assemblies," by V. O. Olsen, North American Aviation, Inc.; March 3, 1953.

"Should We Build Nuclear Powered Rockets," by Dr. H. S. Seifert, California Institute of Technology; and panel discussion: "What is Wrong with Electronic Systems," by Dr. A. M. Zarem (moderator), Stanford Research Institute; E. E. Benyam, KTTV; F. Foulon, Douglas Aircraft; E. A. Holmes, AMTI; R. E. Johnson, Bell Telephone; L. E. Ludekens, So. California Edison, Dr. A. M. Small, USNEL and Dr. Royal Waller, USNAMTC Pt. Mugu; April 7, 1953.

LOUISVILLE

"Rockets in Space," by Dr. C. S. Green, General Electric Aeronautical and Ordnance Systems Division; April 16, 1953.

MONTREAL

"Principles of Transistor Electrophysics and Electronics," by G. C. Sziklai, RCA Laboratories; February 18, 1953.

"Piezo-Electric Crystal Manufacture," by F. H. Margolick, Canadian Marconi Company; March 18, 1953.

"Compatible Colour Television," by R. D. Kell, RCA Laboratories; April 15, 1953.

NEW MEXICO

"Correlation vs. Linear Transforms," by Dr. Bennett Basore, Sandia Corporation; March 27, 1953.

NEW YORK

"Present Status of the Capacitor and Resistor Art with Respect to Electronic Components," by Leon Podolsky, Sprague Electric Company; March 4, 1953.

OMAHA-LINCOLN

"Transmission of Electrocardiagrams over Long Distance Telephone Channels," by Dr. F. L. Dunn, University School of Medicine, Omaha. W. E. Rahm, Jr., University of Nebraska and I. M. Ellestad, Northwestern Bell Telephone Co. also participated; March 25, 1953

OTTAWA

"V.H.F. Scatter Propagation and the Recent C.R.P.L. Findings on Microwave Propagation Over Distances of Several Hundred Miles," by Dr. N. Smith, Naval Bureau of Standards; April 9, 1953.

(*Continued on page 90A*)

Corning Announces a completely new Film-Type Resistor

More rugged! More stable!

If you're looking for a resistor with unusually high electrical stability, here's your answer—Corning Resistors.

The film material is entirely new for resistors. Fired in at red heat, it makes an integral contact with the heat-resistant base to form a tough bond. The result is a rugged unit with exceptional stability, and capable of withstanding high ambient, high operating temperatures.

The resistive element of Corning Resistors is so stable it can be cycled from near absolute zero to red heat without impairing its electrical properties. Fired-in silver bands afford low resistance, low noise terminations.

The mechanical strength of Corning Resistors makes usual handling precautions unnecessary, lowers assembly costs. Mass-produced on automatic machinery, prices are practical. If you use resistors, you can't afford to overlook this important new development. The coupon will bring the information you need. Mail it today!

Corning Load Resistors
These RF and high frequency load resistors combine high power dissipation with exceptional stability and low inductance. For dummy loads, they can be used with forced air or water cooling. Corning Load Resistors can be furnished with resistive coatings either inside or outside the heat-resistant glass tubing.

For maximum precision—Corning Type N Resistors—Where accuracy is important, Corning Type N Resistors have a resistance tolerance of 1%—are ideal for use in critical, low tolerance circuits and high frequency applications. Can be operated at ambient temperatures up to 140° C.

Specifications—Corning Type N Resistors

Power Rating	SIZE *Length*	*Diameter*	RESISTANCE *Min. (ohms)*	*Max. (ohms)*
½ Watt	19⁄32"	11⁄64"	10	10,000
1	1 5⁄16"	19⁄64"	10	40,000
2	2 1⁄16"	19⁄64"	20	100,000

For high temperature operation—Corning Type S Resistors
Capable of operating at ambient temperatures up to 200° C., Corning Type S Resistors have an unusually low temperature coefficient of resistance. They operate at higher power levels—afford important space savings. Thin film construction and inherent stability provide excellent high frequency characteristics. Normal resistance tolerance is 2%.

Specifications—Corning Type S Resistors

Power Rating	SIZE *Length*	*Diameter*	RESISTANCE *Min. (ohms)*	*Max. (ohms)*
1 Watt	19⁄32"	11⁄64"	10	10,000
2	1 5⁄16"	19⁄64"	10	40,000
4	2 1⁄16"	19⁄64"	20	100,000

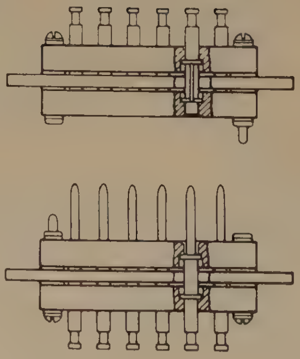
Corning Glass Works
New Products Division
Corning means research in Glass

CORNING GLASS WORKS, Dept. RE-6, Corning, New York
Please send me information on:
☐ Corning Type N Resistors, ☐ Corning Type S Resistors, ☐ Corning Load Resistors
Name .... Title ....
Company ....
City .... Zone .... State ....

Lapp

PLUG-AND-RECEPTACLE UNITS for sectionalizing circuits

- Simultaneous contact of any number of leads can be made or broken by use of Lapp Plug-and-Receptacle units, for panel-rack assembly or other sectionalized circuits. Insulation is steatite, the low-loss ceramic—non-carbonizing, even when humidity, moisture or contamination sets up a leakage path. The unit shown here provides twelve contacts, rated for operation at 2.5kv peak terminal-to-terminal, 1.5kv peak terminal-to-ground, 25 amps at 60 cps. All contacts are silver-plated; terminals are tinned for soldering. Polarizing guide pins assure positive alignment. Write for specifications of this and other available units, or engineering recommendations for special units for your product. Write Lapp Insulator Co., Inc., Radio Specialties Division, 202 Sumner St., Le Roy, N. Y.



- STEATITE INSULATION
- FULL-FLOATING CONTACTS

Lapp

SECTION MEETINGS

(Continued from page 88A)

PITTSBURGH

Audio Recording Symposium. Speakers: W. Steinberg, Conductor, Pittsburgh Symphony Orchestra, Webster Aitken, Faculty, Carnegie Institute of Technology and H. R. Kaiser, Radio Station WWSW; April 13, 1953.

ST. LOUIS

"Analog Computers," by Dr. George Swenson, Faculty, Washington University; January 22, 1953.

"Predicting Maximum Servo-Mechanism Performance," by Ira Ritow, McDonnell Aircraft Corporation; February 26, 1953.

"Binaural Hearing and Auditory Space," by Dr. I. J. Hirsh, Central Institute for the Deaf; March 26, 1953.

SAN ANTONIO

"Correlation and Information Theory," by Dr. C. W. Horton, University of Texas; February 26, 1953.

"Hearing," by Frank Brogan, Randolph AFB; March 26, 1953.

SAN FRANCISCO

"Electronic Engr. Problems Associated with High Frequency Particle Accelerators," by Minard Leavitt, Jack Ridel, D. A. Mack and Wesley Rutz, University of California; March 18, 1953.

SYRACUSE

"Color Television: An Illustrated Progress Report," by Dr. L. R. Fink, General Electric Company; March 23, 1953.

TORONTO

"Servomechanisms," by Dr. J. M. Ham, Associate Prof. of E.E.; March 16, 1953.

"Instrumentation in Aerial Survey," by F. Hanna, P.S.C. Applied Research Ltd.; Election of Officers; April 6, 1953.

TULSA

Student paper competition: "Servo Mechanical Systems," by J. T. Ives, "Transistors," by B. E. Law, and "Why I Want to be a Professional Engineer," by B. C. Paralta, all students, Oklahoma A. & M. College; March 12, 1953.

"Radar Triangulation for Rockets," by R. F. Buck, Oklahoma A. & M. College; March 18, 1953.

VANCOUVER

Tour of C.K.W.X. studio conducted by Charles Smith, Chief Engineer; February 16, 1953.

"Manufacture of Quartz Crystals," by Frank Fraser, Research Industries; March 16, 1953.

WASHINGTON

"Practical Applications of Magnetic Amplifiers," by H. H. Woodson, Naval Ordnance Laboratory; April 13, 1953.

WILLIAMSPORT

"Binaural Sound—a Progress Report and Demonstration," by Norman Jarosik, Sylvania Electric Products Inc.; April 15, 1953.

SUBSECTIONS

HUNTSVILLE

"Capacitors—Their Characteristics, Selection, and Application," by C. G. Killen, Sprague Electric Company; January 22, 1953.

"Ground Controlled Approach Systems," by L. D. Callahan, Gilfillan Bros., Inc.; February 19, 1953.

LANCASTER

"Audio for the Home," by C. G. McProud, Radio Magazines, Inc.; March 11, 1953.

(Continued on page 92A)

transistors

MIGHTY

LITTLE

GIANTS!

Again NORTHERN ELECTRIC LEADS THE FIELD IN CANADA!

The small but vitally important electronic device known as "transistor" is now made in Canada by Northern Electric Company Limited.

Transistors are incorporated into our equipment and are now available as separate units for other applications.

We invite your inquiries for details and further information • Please write to your nearest Northern Electric Office.

Northern Electric
COMPANY LIMITED
DISTRIBUTING HOUSES THROUGHOUT CANADA

2053-3

the most economical way to FOCUS a TV tube

the original Focomag

CUTS RECEIVER COSTS BY ELIMINATING CENTERING AND FOCUSING RHEOSTATS. Also lowers cost of power transformer. Perfectly focuses 27″, 21″ and all smaller tubes having magnetic deflection. Highly efficient ring magnet uses only 4 oz. Alnico P. M.

NO HARMFUL EXTERNAL FIELD. Ring magnet is completely enclosed by the external shunt (an original Heppner design). This prevents the leakage field from having any magnetic effect on other components. Uniform field produced by ring magnet.

FLEXIBLE NYLON ADJUSTING SHAFT ELIMINATES BREAKAGE.
Picture-positioning lever. You specify mounting arrangement.

Write today for information on lowering your set costs with this FOCOMAG.

HEPPNER
MANUFACTURING COMPANY
Round Lake, Illinois (50 Miles Northwest of Chicago)
Phone: 6-2161
SPECIALISTS IN ELECTRO-MAGNETIC DEVICES

Representatives:

John J. Kopple
60 E. 42nd St., New York 17, N. Y.

James C. Muggleworth
506 Richey Ave., W. Collingswood, N. J.

Ralph Haffey
R. R. 1, U. S. 27, Coldwater Rd.,
Ft. Wayne 3, Indiana

Irv. M. Cochrane Co.
408 So. Alvarado St., Los Angeles, Calif.

SECTION MEETINGS

(Continued from page 90A)

LONG ISLAND

"An Ultrasonic Machine Tool," by Neil Clark, Jr., Raytheon Manufacturing Company. Paper discussed by N. B. Nichols, also of Raytheon Manufacturing Company; March 10, 1953.

MID-HUDSON

"Reliability of Electron Tubes," by W. R. Jones, Faculty, Cornell University; February 16, 1953.

MONMOUTH

"Home Music Systems," by C. D. McProud, Audio Engineering Magazine; February 18, 1953. Field trip to Brookhaven Laboratories; March 21, 1953.

NORTHERN NEW JERSEY

Symposium: Electron Tube Reliability. Speakers: J. O. McNally, Bell Telephone Labs.; J. Prager, RCA; A. Heitner, Sylvania Electric Products; R. Whittier, Raytheon Manufacturing Company, J. Wyman and A. Warsher of Bendix Aviation Corp.; March 11, 1953.

ORANGE BELT

"From Cat's Whisker to Transistor—My Fifty Years in Electronics," by Dr. A. H. Taylor, Naval Research Laboratories; February 11, 1953.

"Problems of Space Navigation," by J. M. Wuerth, North American Aviation, Inc.; April 8, 1953.

PALO ALTO

"Electronics in Medicine: A Review of Current Practice and Future Trends," by Dr. J. M. Crismon, Stanford University and Dr. L. B. Lusted, University of California Hospital. Paper discussed by Dr. D. K. Reynolds, Stanford Reaserch Institute, Mr. William Siri, University of California and Dr. Henry Newman, Stanford University Medical School; March 10, 1953.

WICHITA

Discussion and demonstration of communication facilities by P. H. Messner, Tower Chief, C.A.A. and exhibit and discussion on equipment used for maintenance and weather station, by L. S. Rich, Station Chief, C.A.A.; January 28, 1953.

"Concepts and Components for Modern Miniature Design," by Yale Jacobs, Wright Air Development Center; March 20, 1953.

Student paper competition: "Modern Aids to Competition," by W. A. Murray, Student, University of Kansas; "Basic Analysis of Feedback Control Systems," by J. B. Jensen, Student, Kansas State College and "The Omni-Directional Radio Range," by R. E. Spence, Student, University of Arkansas; April 14, 1953.

STUDENT BRANCH MEETINGS

AGRICULTURAL & MECHANICAL COLLEGE OF TEXAS, IRE-AIEE BRANCH

"Supervisory Control," by L. J. Phillips and "Record Player for Use in a Car," by T. B. Davison, both Students; March 17, 1953.

"Tracking of Hurricanes by Radar," by Mr. Jorganson; March 31, 1953.

(Continued on page 94A)

Do you have this handy new catalog?

You'll find it mighty useful. It covers the whole standard line of Speer Resistor Division Products:

FIXED COMPOSITION RESISTORS
MOLDED WINDING FORMS
IRON CORES
SLEEVE CORES
COIL FORMS

It tells everything you'll want to know about these products—their specifications, their characteristics, their applications.

If you don't already have a copy, mail the coupon below.

SPEER
RESISTOR

SPEER RESISTOR DIVISION
SPEER CARBON COMPANY
St. Marys, Pennsylvania
Other Divisions:
Jeffers Electronics
International Graphite & Electrode

OTHER SPEER PRODUCTS FOR THE ELECTRONICS INDUSTRY
anodes • contacts • fixed carbon resistors • coil forms discs • brushes • battery carbon • graphite plates and rods
also
R.F. Coils • ceramic capacitors • capristors • high voltage condensers • disc capacitors • chokes made by Jeffers Electronics

P-6

Speer Resistor Division
Speer Carbon Company
St. Marys, Pennsylvania

Please send me a copy of your new catalog covering the complete standard line of Speer Resistor Division products.

Name________________Position________

Company________________________

Address________________________

City____________Zone______State________

PLANT...

PRODUCT...

PROCESS

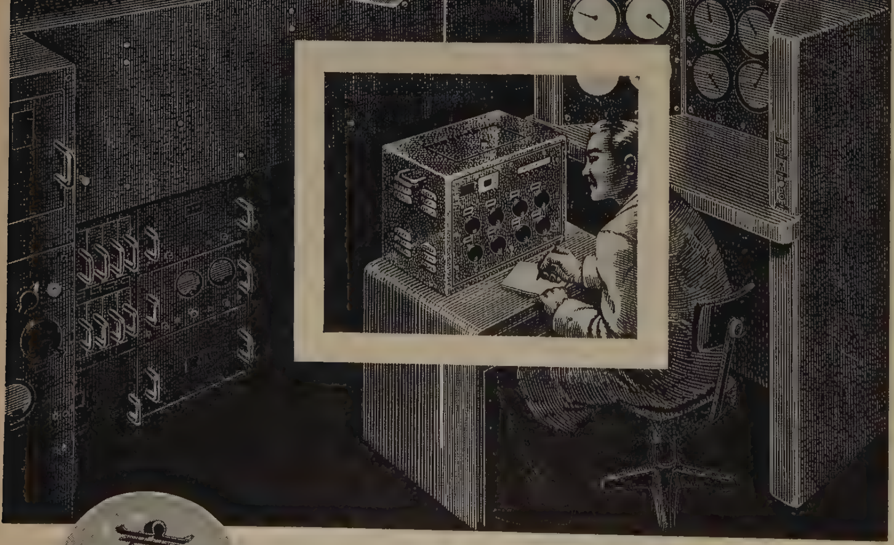
analyzed-controlled
by Librascope...

Whatever the function, Librascope *simplified* Computers and Controls are introducing new efficiency . . . in plant, product and process control of continuous or batch production. *Whatever your specific need . . .* Librascope, Inc., designers and manufacturers of both Analog and Digital Computers and Controls, can give you functionally designed equipment packaged to give the utmost in reliability and performance.

Whatever your problem-solving background in engineering or physics, if you are experienced in computers, instrumentation, circuitry, and/or magnetic devices, you will want to know more about Librascope's plans for the future.

The Simultaneous Equation Solver,

an *integral* part of Baird Associates, Inc. new spectograph, is a *simplified* analog computer that resolves the machine's complex data output.



If you desire the challenge of advanced design fields, write to Dick Hastings, Director of Personnel.

Analog and Digital Computers,
Input-Output Devices,
and Components

LIBRASCOPE
INCORPORATED

1607 FLOWER STREET, GLENDALE 1, CALIFORNIA

A SUBSIDIARY OF GENERAL PRECISION EQUIPMENT CORPORATION

STUDENT BRANCH MEETINGS

(Continued from page 92A)

UNIVERSITY OF CALIFORNIA, IRE-AIEE BRANCH

General meeting; February 24, 1953.

General meeting; March 10, 1953.

Field trip to Ryan High Voltage Lab., University of Stanford; March 20, 1953.

"Around the World Tour for the Engineer," by Prof. C. F. Dalziel, Advisor to UCSEE; April 2, 1953.

Executive meeting; April 7, 1953.

CARNEGIE INSTITUTE OF TECHNOLOGY, IRE-AIEE BRANCH

"Personal Experiences in Electrical Engineering," by H. D. James, H. D. James Company; Film, "Induction Heating"; April 1, 1953.

UNIVERSITY OF COLORADO, IRE-AIEE BRANCH

"The Electro-Encephalograph," by Stan Johnson, "Electronic Analog Computers," by Richard Richardson and "The Williamson Type Amplifier: Development and Performance," by John Shaver, all Students; March 11, 1953.

"The Transistor," by T. R. Finch, Bell Telephone Laboratories; March 17, 1953.

UNIVERSITY OF CONNECTICUT, IRE-AIEE BRANCH

Talk on basic meter theory and general problems involved in instrumentation, by Henry Berring, Weston Instrument Company; April 9, 1953.

Election of officers; April 17, 1953.

UNIVERSITY OF DAYTON, IRE BRANCH

"A 48 Hour Continuous Recorder," by C. Abel and J. Sullivan, Signal Corps Engineering Laboratories; March 10, 1953.

"Radiation and Radiation Patterns," by Donald Bange, Student, University of Dayton; March 24, 1953.

UNIVERSITY OF DENVER, IRE-AIEE BRANCH

Election of officers; April 10, 1953.

Business meeting; April 17, 1953.

FENN COLLEGE, IRE BRANCH

"Spectrochemical Analysis," by J. T. Rozsa, National Spectrographic Laboratories; March 25, 1953.

GEORGE WASHINGTON UNIVERSITY, IRE BRANCH

"Servomechanisms," by William Ahrendt, Ahrendt Instrument Company; April 1, 1953.

GEORGIA INSTITUTE OF TECHNOLOGY, IRE BRANCH

"Fluid Mapping Techniques," by A. D. Moore, Faculty, University of Michigan; April 6, 1953.

ILLINOIS INSTITUTE OF TECHNOLOGY, IRE BRANCH

"Tape Recorders," by Marvin Camras, ARF Senior Physicist; Marcy 18, 1953.

"Electronics in the Navy," by Lt. E. L. Cochrane, I.I.T. NROTC unit; April 1, 1953.

"Mobile Communications," by K. V. Glantzer, Illinois Bell Telephone Company; April 15, 1953.

STATE UNIVERSITY OF IOWA, IRE BRANCH

General meeting; March 18, 1953.

"Electrical Measuring Devices," by Henry Berring, Weston Electrical Instrument Corporation; March 23, 1953.

"Student Papers Contests," by Dr. E. B. Kurtz, Faculty, State University of Iowa; April 1, 1953.

"Solomon's House," by T. A. Boyd, General Motors; April 8, 1953.

KANSAS STATE COLLEGE, IRE BRANCH

"Operation of Three Phase Motors on Single Phase Lines," by John Hooper, "A New Electrostatic Generator," by Charles Hardin and "Basic Analysis of Feedback Control," by James Jensen; March 26, 1953.

(Continued on page 96A)

Over 85% of the torque wrenches used in industry are

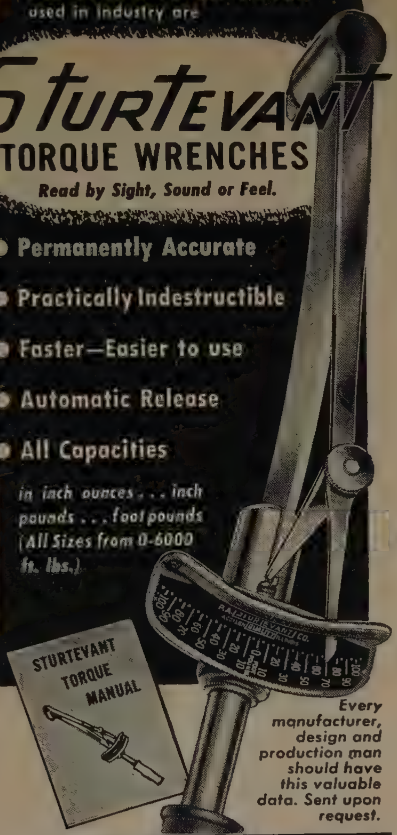
Sturtevant

TORQUE WRENCHES

Read by Sight, Sound or Feel.

- **Permanently Accurate**
- **Practically Indestructible**
- **Faster—Easier to use**
- **Automatic Release**
- **All Capacities**

in inch ounces . . . inch pounds . . . foot pounds (All Sizes from 0-6000 ft. lbs.)



Every manufacturer, design and production man should have this valuable data. Sent upon request.

P.A. STURTEVANT CO.
ADDISON QUALITY ILLINOIS

A NEW UNIVERSAL KLYSTRON

POWER SUPPLY

— for

MICROWAVE OSCILLATORS

PRD

- Operates all low power commercial klystrons.
- Positive or negative grid operation.
- Widest modulation frequency range.
- Beam voltage: Regulated continuously variable over ranges of 300 to 1500 v. at 65 ma. or to 3600 v. at 25 ma.
- Repeller voltage: Direct reading continuously variable over the range of −20 to −750 volts.
- Modulation: Square wave, saw tooth, external or highly stable c-w operation.

Specify the PRD Model 801-A

Polytechnic
RESEARCH & DEVELOPMENT CO., Inc.

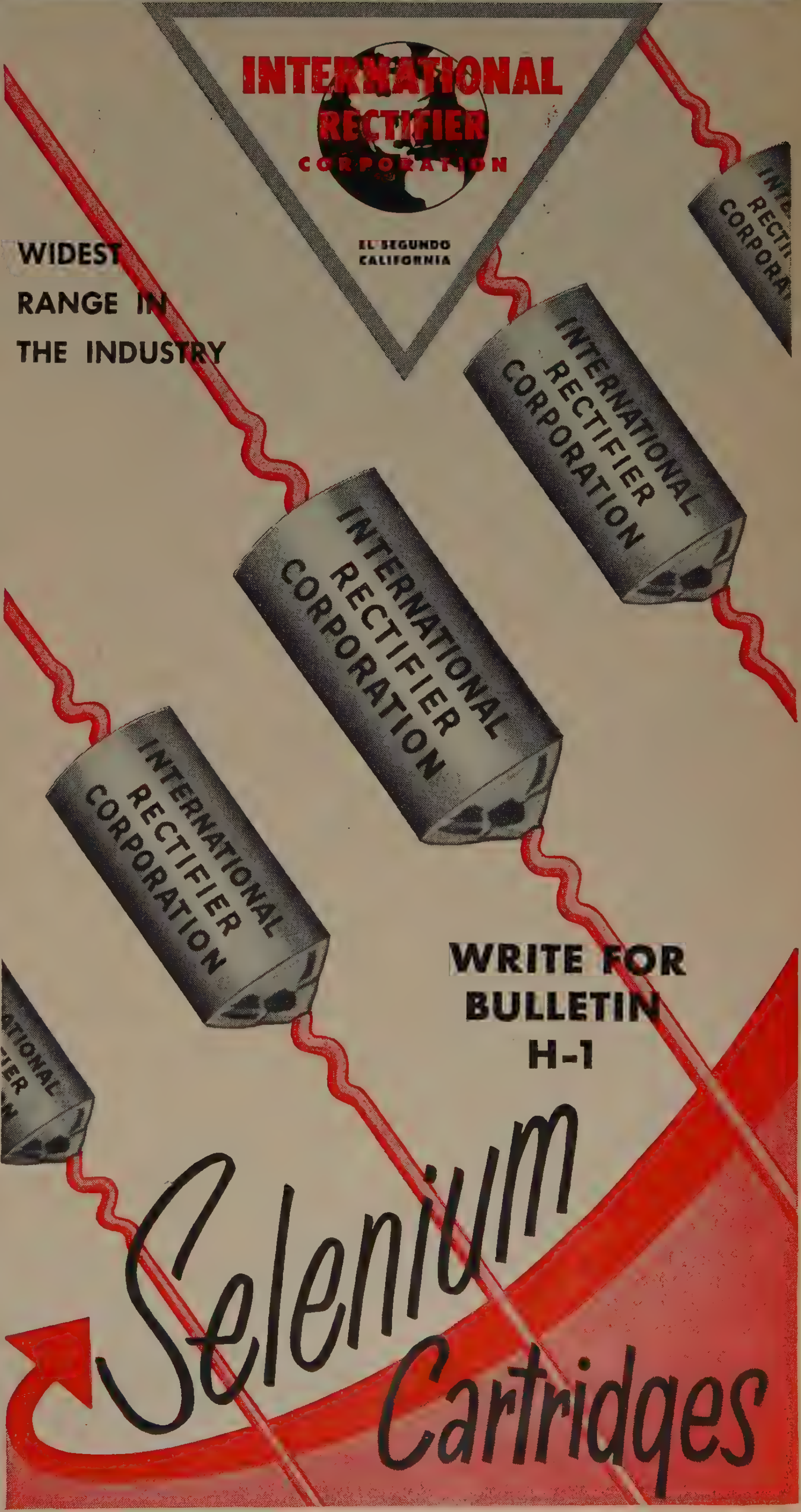
55 JOHNSON ST., BROOKLYN 1, NEW YORK
West Coast: 741 N. Seward St., Hollywood 38, Calif.

INTERNATIONAL RECTIFIER CORPORATION

1521 E. Grand Ave., El Segundo, Calif. Phone: ORegon 8-3778
CHICAGO: 205 W. Wacker Drive. Phone: Franklin 2-3889
NEW YORK: 12 W. 32nd. St. Phone: Chickering 4-0016

INTERNATIONAL RECTIFIER CORPORATION
EL SEGUNDO CALIFORNIA

WIDEST RANGE IN THE INDUSTRY


INTERNATIONAL RECTIFIER CORPORATION
INTERNATIONAL RECTIFIER CORPORATION
INTERNATIONAL RECTIFIER CORPORATION
Selenium Cartridges

WRITE FOR BULLETIN H-1

NEW Type 2113, 12-Channel
PICTURE SIGNAL GENERATOR
for Production Testing and Closed-Loop T.V.

The Type 2113, 12 Channel Picture Signal Generator has been specifically designed for production line testing of TV receivers. Used in conjunction with the equipment listed below, the manufacturer can produce his own "Indian Head" test pattern and is no longer dependent on local transmissions. This signal generator has also received wide acceptance for dealer demonstrations of TV receivers in areas where transmitting facilities are not yet available.

SPECIFICATIONS

OUTPUT SIGNALS AND ACCURACY: Picture and sound R. F. signals on all 12 standard TV channels. Picture carrier accuracy 0.01%; sound carrier better than ±4.5 KC of "standard" on all channels.

PICTURE CARRIER OUTPUT: At least 50,000 microvolts into a 75 ohm terminated coaxial cable.

R. F. OUTPUT IMPEDANCE: Output is into a 75 ohm coaxial cable. Two probes are supplied for use with 75 ohm cable to match 75 or 300 ohm receiver antenna input circuits.

VIDEO INPUT IMPEDANCE: 75 ohms single ended.

VIDEO INPUT: Minimum 1 Volt Peak to Peak, black negative polarity.

PICTURE CARRIER MODULATION: Continuously variable 0 to 87%.

D. C. RESTORER: A D.C. restorer is provided to maintain constant average picture brightness when using program material for video modulation.

SOUND CARRIER DEVIATION: Continuously variable 0 to 40 KC.

SOUND MODULATION: Modulation from 400 cps internal oscillator or external signal such as music. Input either high impedance, unbalanced, or 600 ohms balanced. Either input can be selected by front panel switch.

These other TIC Instruments complete the "package"

TYPE 2120 PICTURE SIGNAL GENERATOR: A single channel TV transmitter for use where a high percentage of picture modulation is required for checking inter-carrier buzz.

TYPE 1311 VIDEO DISTRIBUTION AMPLIFIER: A 5 channel amplifier recommended where multiple 75 ohm, unity gain outlets are desired.

TYPE 2200 SYNC. SIGNAL GENERATOR: Provides all necessary RTMA sync. blanking and drive signals plus linearity blanking, in either polarity, for monoscope or studio camera operation.

TYPE 2300 MONOSCOPE: A "must" for checking linearity, resolution and smear in TV receivers and video distribution facilities. Recommended for use with Type 2200 Sync-Generator.

Manufacturers of a Complete Line of TV Test Equipment
TIC Tel-Instrument Co. Inc.
50 PATERSON AVENUE • EAST RUTHERFORD, N. J.

STUDENT BRANCH MEETINGS

(Continued from page 94A)

UNIVERSITY OF MAINE, IRE BRANCH

"High Tension Switching and Substation Protection," by Gerald Hart and Richard Stadtfeld, Engineers of Bangor Hydro Electric Company and Westinghouse Electric Company; March 16, 1953.

"Principles of Protective Relaying," by A. S. Hill, Professor Emeritus of Electrical Engineering, April 16, 1953.

MANHATTAN COLLEGE, IRE-AIEE BRANCH

"Insulation Resistance," by W. G. Long, James G. Biddle Company; April 15, 1953.

UNIVERSITY OF MARYLAND, IRE-AIEE BRANCH

"Some Aspects of Electrical Systems Operation," by E. S. Bailey and F. H. Rogers, Consolidated Gas, Electric Light and Power Company; April 15, 1953.

UNIVERSITY OF MIAMI, IRE BRANCH

"Philosophy of Microwave Equipment Design," by J. R. McKenna, Philco Corporation; February 24, 1953.

"Transistors—Theory and Application" with demonstration, by Howard Lefkowitz, Student, University of Miami; March 5, 1953.

"Demonstration of Laboratory Electronic Equipment," by Arthur H. Lynch, Arthur H. Lynch and Associates; March 12, 1953.

"VHF Navigational Equipment," by H. L. Gauntt, Student, University of Miami; April 2, 1953.

MICHIGAN COLLEGE OF MINING & TECHNOLOGY, IRE-AIEE BRANCH

Business meeting; March 17, 1953.

Election of officers; March 31, 1953.

"Report on the American Power Conference," by R. R. Hocking, Student, Michigan College of Mining and Technology; April 14, 1953.

UNIVERSITY OF MICHIGAN, IRE-AIEE BRANCH

"Naval Shore Based Electronics," by E. D. Redington, Cmdr., USN; February 18, 1953.

"Rocket Borne Electronic Devices in Upper Atmosphere Research," by N. W. Spencer, University of Michigan Research Institute; March 20, 1953.

UNIVERSITY OF MINNESOTA, IRE-AIEE BRANCH

"The Instrument Story," by Henry Berring, Weston Electrical Instrument Corporation; March 11, 1953.

MISSISSIPPI STATE COLLEGE, IRE BRANCH

"Micro-wave Transmission," by Francis Lundy, Southern Bell Telephone & Telegraph; April 9, 1953.

UNIVERSITY OF MISSOURI, IRE-AIEE BRANCH

"The Rotating Field," by M. Chairottino, Student, and Film, "Report on the Atom"; March 24, 1953.

Election of officers; March 31, 1953.

MISSOURI SCHOOL OF MINES & METALLURGY, IRE-AIEE BRANCH

"Vacuum Tube Reliability," by Richard Meek, "Grounding Resistance," by George McCormick and "Hydrogen Cooling of Generators," by Henery Striegl; Election of officers; March 19, 1953.

UNIVERSITY OF NEBRASKA, IRE-AIEE BRANCH

"Transmission of Electrocardiograms over Long Distance Telephone Channels," by Dr. F. L. Dunn, W. E. Rohn, Jr., Dr. J. Barmore and I. M. Ellestad; March 25, 1953.

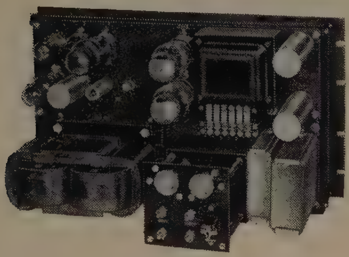
Election of officers; April 1, 1953.

(Continued on page 98A)

TO MAINTAIN CONSTANT OUTPUT VOLTAGES STABILINE *Automatic* VOLTAGE REGULATORS

are available in 2 DISTINCT TYPES

TYPE IE INSTANTANEOUS ELECTRONIC



For the most exacting control

featuring:

INSTANTANEOUS CORRECTION — as compared with any other type. Operation is entirely electronic without moving parts. Complete correction is effected in 3 to 10 cycles depending on variations in line voltage, load current, load power factor and other conditions.

EXCELLENT STABILIZATION AND REGULATION — The maximum change in output voltage will not exceed: ±0.25 per cent for any or all changes or variations in operating conditions — ±0.1 per cent for input voltage changes — ±0.15 per cent for load current or power factor changes from lagging 0.5 to leading 0.9.

MINIMUM WAVEFORM DISTORTION — Except under the most adverse conditions, distortion is usually under 2 per cent.

MUCH WIDER INPUT RANGE — than most competitive types. Ranges are 95-135 volts for a nominal output of 115 volts and 195-255 volts for a nominal output of 230 volts.

ADJUSTABLE OUTPUT VOLTAGE — Output from a nominally 115 volt unit is adjustable from 110 to 120 volts and from 220 to 240 volts on a nominally 230 volt unit.

INSENSITIVITY TO FREQUENCY CHANGES — but to maintain optimum correction characteristics, tolerances should not exceed ±10 per cent of the specified frequency.

STANDARD MODELS — are available in numerous ratings in capacities up to 5.0 KVA.

. . . AND SPECIAL TYPES

application engineered to meet individual requirements

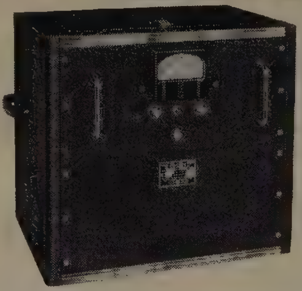
Specializing in the design, development and manufacture of Voltage Control Apparatus, The Superior Electric Company offers its experience to help in solving any voltage control problem. The Superior Electric Company is pleased to analyze your individual needs and will recommend the STABILINE Automatic Voltage Regulator best suited to your application.

THE SUPERIOR ELECTRIC CO
BRISTOL, CONNECTICUT

Manufacturers of

- POWERSTAT VARIABLE TRANSFORMERS
- STABILINE AUTOMATIC VOLTAGE REGULATORS
- VOLTBOX A-C POWER SUPPLIES
- POWERSTAT LIGHT DIMMING EQUIPMENT
- VARICELL D-C POWER SUPPLIES
- SUPERIOR 5-WAY BINDING POSTS

TYPE EM ELECTRO MECHANICAL



to control industrial loads – offer zero waveform distortion

featuring:

UNUSUALLY HIGH EFFICIENCY — is an outstanding feature of the Type EM. It is comparable to that of the most conservatively designed fixed-ratio transformers.

ZERO WAVEFORM DISTORTION — is a primary requirement for many electronic applications. Type EM provides a constant output voltage which is a faithful and distortionless reproduction of the applied input waveform.

RAPID CORRECTION — Type EM is an electro mechanical device. While it does not correct instantaneously, it provides faster correction than most other automatic voltage regulators.

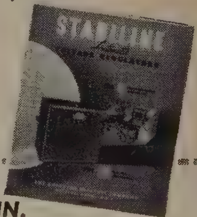
WIDE INPUT RANGE — is another important feature. Range is 95-135 volts for a nominally 115 volt unit; 195-255 volts for a 230 volt unit; 400-520 volts for the 460 volt units.

ADJUSTABLE OUTPUT VOLTAGE — Output from a 115 volt unit is adjustable from 110 to 120 volts; output from a 230 volt unit is adjustable from 220 to 240 volts; output from a 460 volt unit is adjustable from 420 to 460 volts.

INSENSITIVE TO FREQUENCY AND SYSTEM POWER FACTOR — Designed for 50/60 cycle power lines, all of the Type EM will perform satisfactorily at any frequency from 45 to 65 cycles. In addition, Type EM is insensitive to the magnitude and power factor of the load and has no effect on the system power factor.

STANDARD MODELS — are available for 115, 230 or 460 volt, 50/60 cycle, single and three phase operation in capacities up to 100 KVA.

SEND COUPON TODAY FOR BULLETIN S351 featuring engineering and application data on STABILINE Types IE and EM.



THE SUPERIOR ELECTRIC CO.
1106 MAE AVENUE, BRISTOL, CONN.

Please send my copy of Bulletin S351.

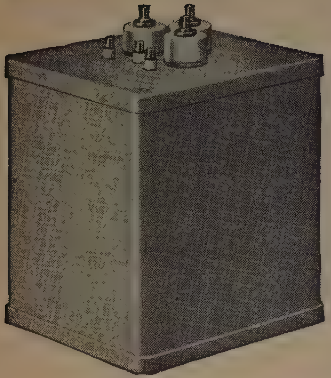
NAME ____________________

POSITION ____________________

CO. NAME ____________________

CO. ADDRESS ____________________

CITY ____________ ZONE ____ STATE ____________



Quality COMES FIRST

• If performance and long life are the primary factors in your application of transformers, then submit your specifications to Acme Electric. Quality comes first in every Acme Electric transformer.

ACME ELECTRIC CORPORATION
446 WATER STREET • CUBA, N.Y.
In Canada: ACME ELECTRIC CORP. LTD.
50 North Line Rd. Toronto, Ont., Canada

Acme ACME Electric
TRANSFORMERS

SECON

DEVELOPMENT and PRODUCTION METALLURGISTS

Fine wire and ribbon in base, rare, and precious metals, and alloys for new and highly engineered applications. In small units and sizes, and to close tolerances.

Further details on request.

SECON

SECON METALS CORPORATION
228 East 45th Street, N. Y. 17, N. Y., MU 7-1594

STUDENT BRANCH MEETINGS

(Continued from page 96A)

New Mexico College of Agriculture & Mechanic Arts, IRE-AIEE Branch

"Engineering in a Nut-Shell," by Frank Bromilow, Faculty, New Mexico College A & M; February 5, 1953.

General meeting; February 20, 1953.

College of the City of New York, IRE Branch

"Microwaves," by W. Britnell, Bell Telephone Company; March 19, 1953.

"Microwave Magic," by Mr. Britnell, Bell Telephone Company; March 26, 1953.

New York University (Eve. Div.), IRE-AIEE Branch

"Effects of Sunspots and Planetary Interrelations on our Ionosphere," by J. H. Nelson, RCA Communications; April 10, 1953.

Oklahoma Agriculture & Mechanical College, IRE-AIEE Branch

"Servomechanism Systems," by J. T. Ives, "The Transistor," by B. E. Law and "Why I Want to Become a Professional Engineer," by B. C. Peralta, all Students, Oklahoma A & M College; March 12, 1953.

Election of officers; March 30, 1953.

Pennsylvania State College, IRE-AIEE Branch

Composite talk by Prof. M. Tarpley and the following speakers: "Transistors," by M. Ristenbatt, "Lead Networks with a Memory," by Norman Grey, "Optimizing System for Process Control," by John Tomlison, "Magnetic Amplifiers," by S. Pfeiffer, "UHF Negative Grid Oscillator," by J. Kretzing and "Reciprocity Theorem in Electro-Mechanical Systems," by W. Baker; January 12, 1953.

"Type A XY Toll Ticketing System," by H. L. Foote, Stromberg Carlson Company; February 24, 1953.

"Business Manners," by W. E. Kenworthy, Director of Student Affairs at Penn State; March 4, 1953.

"The Place of Public Utilities in our Expanding Economy," by Mr. Astley, Philadelphia Electric Company; March 17, 1953.

University of Pennsylvania, IRE-AIEE Branch

Business meeting; March 2, 1953.

"Circuit Design for Delay Lines," by Y. Lubkin and "The Epodential Audio Horn," by S. Margolis, both students; March 6, 1953.

"The Watthour Meter," by C. U. Burmaster, General Electric Company; March 10, 1953.

Tour of Studios of WCAU-TV; March 20, 1953.

University of Pittsburgh, IRE Branch

"Travelogue of the Northwest," by Col. Anderson, Union Pacific Railroad; March 26, 1953.

"Electrical Indicating Instruments," by Henry Berring, Weston Electrical Instrument Corporation; April 23, 1953.

Rutgers University, IRE-AIEE Branch

"Analogue Computers," by D. A. Molony, Asst. Prof., Dept. of E.E.; April 9, 1953.

"Instruments," by H. Berring, Weston Instrument Corporation; April 16, 1953.

San Diego State College, IRE Branch

Field trip to CBS Television Studios; April 3, 1953.

San Jose State College, IRE Branch

"Transistors," by Harry Engwight, Faculty, San Jose State College; April 3, 1953.

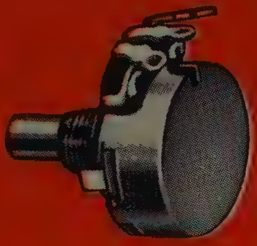
(Continued on page 102A)

COMPLETE MILITARY LINE

Immediate delivery from stock on 189 types including JAN-R-94 and JAN-R-19 types of variable resistors.

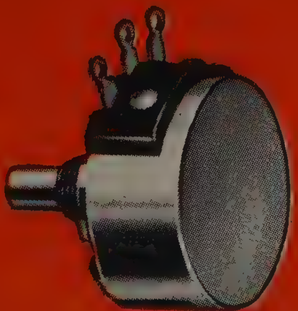
NEW 38-PAGE ILLUSTRATED CATALOG—

Describes Electrical and Mechanical characteristics, Special Features and Constructions of a complete line of variable resistors for military and civilian use. Includes dimensional drawings of each resistor. *Write today for your copy.*

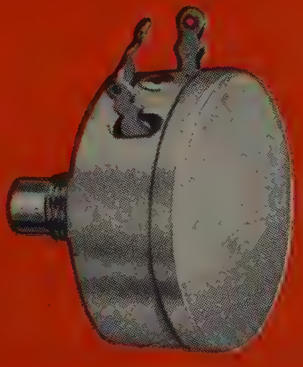


TYPE 45, (JAN-R-94, Type RV2)
1/4 watt, 15/16" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

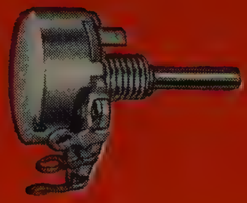
TYPE 35, (JAN-R-94, Type RV3)
1/2 watt, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.



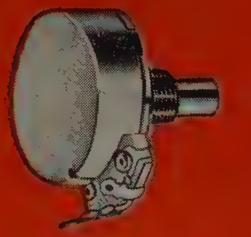
TYPE 252, (JAN-R-19, Type RA20)
2 watt, 1 17/64" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



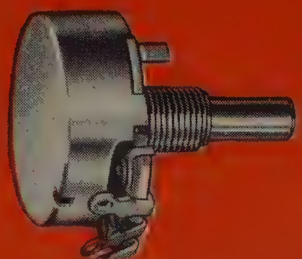
TYPE 25, (JAN-R-19, Type RA30)
(May also be used as Type RA25)
4 watt, 1 17/32" diameter variable wirewound resistor. Also available with other special military features not covered by JAN-R-19 including concentric shaft tandem construction. Attached switch can be supplied.



TYPE 65, (Miniaturized)
1/2 watt 70°C, 3/4" diameter miniaturized variable composition resistor.



TYPE 90
1 watt 70°C, 15/16" diameter variable composition resistor. Attached switch can be supplied. Also available in concentric shaft tandem construction.



TYPE 95, (JAN-R-94, Type RV4)
2 watt 70°C, 1 1/8" diameter variable composition resistor. Also available with other special military features not covered by JAN-R-94 including concentric shaft tandem construction. Attached switch can be supplied.

UNPRECEDENTED
PERFORMANCE CHARACTERISTICS

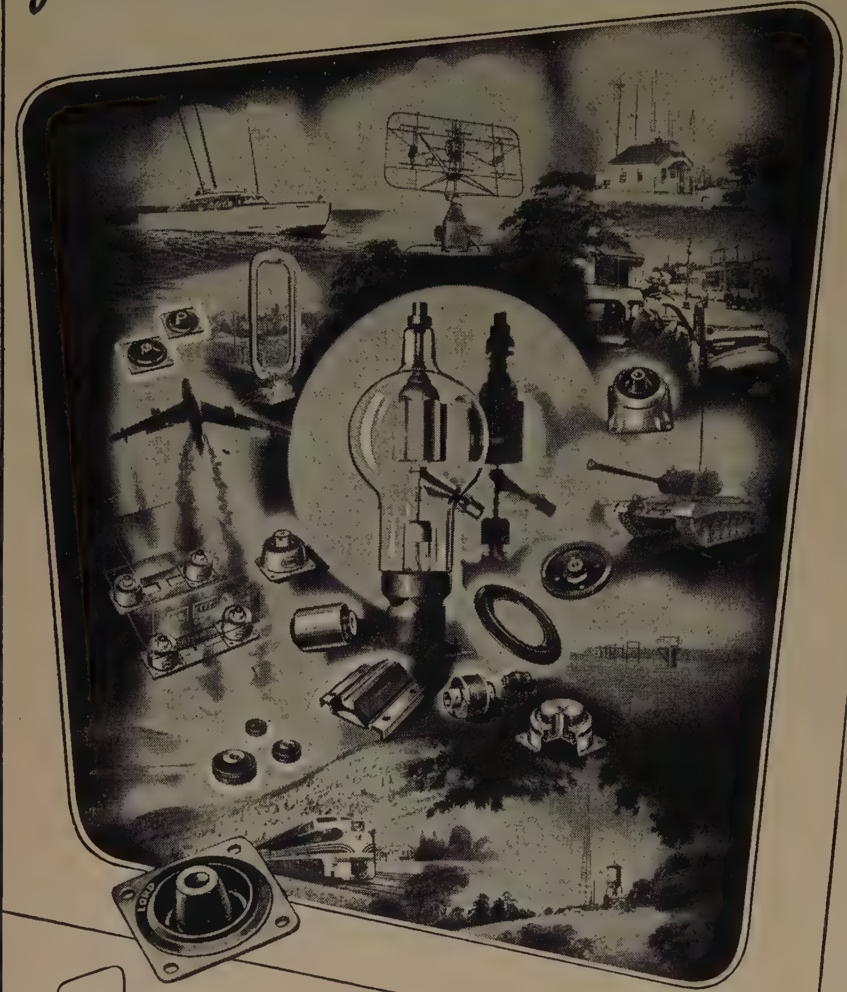
Specially designed for military communications equipment subject to extreme temperature and humidity ranges. -55°C to +150°C...aridity to saturation.

CTS

CHICAGO TELEPHONE SUPPLY
Corporation

ision Mass Production of Variable Resistors

LORD MOUNTINGS PROTECT INSTRUMENTS
and ELECTRONIC EQUIPMENT
from VIBRATION *and* SHOCK DAMAGE • • •



VIBRATION and shock are natural enemies of electronic equipment and precision instruments . . . To control the damage which these enemies can do, Lord Vibration Control Mountings and Bonded Rubber Parts are used to very profitable advantage. More than a quarter century's experience in dealing with vibration and shock is yours when you take advantage of Lord engineering assistance. The result of such consultation is full protection for electronic units and sensitive instruments by correctly designed and precisely manufactured Lord Mountings and Bonded-Rubber parts.

BURBANK, CALIFORNIA
233 South Third Street

DALLAS, TEXAS
413 Fidelity Union Life Building

PHILADELPHIA 7, PENNSYLVANIA
725 Widener Building

DAYTON 2, OHIO
410 West First Street

DETROIT 2, MICHIGAN
7310 Woodward Ave.

NEW YORK 16, NEW YORK
280 Madison Avenue

CHICAGO 11, ILLINOIS
520 N. Michigan Ave.

CLEVELAND 15, OHIO
Room 811, Hanna Bldg.

LORD MANUFACTURING COMPANY • ERIE, PA.

LORD BONDED RUBBER

Headquarters for
VIBRATION CONTROL

STUDENT BRANCH MEETINGS

(Continued from page 98A)

UNIVERSITY OF SOUTHERN CALIFORNIA, IRE-AIEE BRANCH

General meeting; February 25, 1953.

UNIVERSITY OF TEXAS, IRE-AIEE BRANCH

"Lightning Protection for Electrical Systems," by E. H. Eldridge, General Electric Company; April 13, 1953.

TULANE UNIVERSITY, IRE-AIEE BRANCH

Business Meeting; February 25, 1953.

"Transistors," by J. D. Stokes, Jr., Student, Tulane University; March 4, 1953.

Business meeting; March 12, 1953.

"Lightning Protection," by R. Mouton and "Power Generation from Wind," by H. Boisseau, both Students; March 20, 1953.

"Importance of the Professional Society," by E. S. Lammers, Vice-Pres. of AIEE, District 4; election of officers; April 1, 1953.

UTAH STATE AGRICULTURAL COLLEGE, IRE BRANCH

Election of officers; March 18, 1953.

Annual banquet and installation of officers; March 30, 1953.

UNIVERSITY OF WASHINGTON, IRE-AIEE BRANCH

Field trips; February 21 and 22, 1953.

General meeting; February 26, 1953.

"Use of Electronics in the B.P.A. Power Network," by C. E. Sterett, Bonneville Power Administration; March 5, 1953.

Election of officers; April 14, 1953.

WAYNE UNIVERSITY, IRE-AIEE BRANCH

"Professional Registration for the Engineer," by D. E. Trefry, Delegate at Large—Professional Engineering Soc.; March 5, 1953.

UNIVERSITY OF WISCONSIN, IRE BRANCH

Business meeting; March 12, 1953.

WORCESTER POLYTECHNIC INSTITUTE, IRE-AIEE BRANCH

"Quadrature Axis—Synchronous Reactance," by P. T. Petrides, "Oceanographic Instruments," by G. E. Saltus and "Induction Motor Diagrams," by P. E. Simon, Jr., all students; April 7, 1953.

UNIVERSITY OF WYOMING, IRE-AIEE BRANCH

Film, "X-Ray Inspection Methods"; February 10, 1953.

Election of officers and film, "Television Lighting"; April 7, 1953.

MEMBERSHIP

The following transfers and admissions were approved to be effective as of June 1, 1953:

Transfer to Senior Member

Ahmed, W., Department of Electrical Engineering, Engineering College, Dacca, East Pakistan
Baran, M., 4828 Airway Rd., Dayton 3, Ohio
Broomall, J. M., Hampton Rd. and Crefeld St., Philadelphia 18, Pa.
Butler, R. W., Bendix Aviation Corporation, Kansas City 10, Mo.
Chudleigh, W. H., Jr., 502 Enfield Rd., Oreland, Pa.
Clark, J. M., 113 E. Hickory St., Hinsdale, Ill.
Colander, R. E., 6840 Garden Grove Ave., Reseda, Calif.

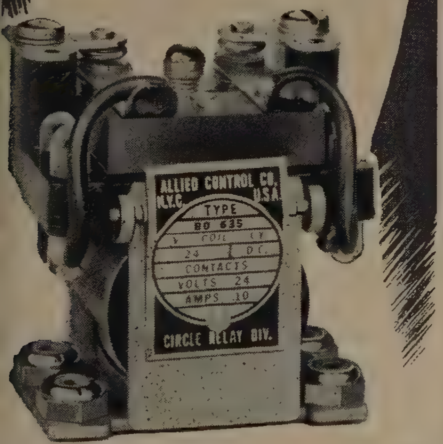
(Continued on page 104A)

24 HOUR DELIVERY FROM STOCK!

RELAYS

Our stock of more than a million relays — in over a thousand different types — is the world's largest. Don't delay your production for want of large or small quantities of relays of any type.

Telephone, wire or write for quotations.



NEW AND MORE COMPREHENSIVE

1953
RELAY SALES CATALOG
NOW READY

Be sure to send for your copy

Relay Sales

Telephone
SEeley 8-4146

833 W. CHICAGO AVE.
DEPT. 7, CHICAGO 22, ILL.

JK PRODUCTS

Speeding Electronic Progress through
crystal research

The new JK G-9 is a medium priced, high precision, 100 kc frequency standard crystal available for use with or without oven, depending on tolerances desired. Supplied for operation at series resonance or into specified load capacities. Hermetically sealed, evacuated glass holder provides thermal insulation, protection against contamination. Consult us on specific applications.

JK STABILIZED G-9 CRYSTAL

Did you know? So accurately processed are JK Crystals that dimensions must be checked electrically and even the touch of a hand will change their characteristics. Yet, in a protective, "stabilized" JK mounting they maintain precise frequency with unfailing accuracy Creative research combined with precision production methods brings you JK "Crystals for the Critical."

THE JAMES KNIGHTS COMPANY
SANDWICH, ILLINOIS

Precision ATTENUATION to 3000 mc!

- VSWR less than 1.2 at all frequencies to **3000 mc.**
- **TURRET ATTENUATOR** featuring **"Pull - Turn - Push"** action with 0, 10, 20, 30, 40, 50 DB steps.
- Accuracy ±.5 DB, no correction charts necessary.
- 50 ohm coaxial circuit. Type N Connectors.

COAXIAL LINE TERMINATION
50 ohms

SINGLE ATTENUATOR PAD
50 ohms

VSWR ± 1.2 to 3000 mc.
One watt c.w. power dissipation

Inquiries are invited concerning single pads and turrets having other characteristics

STODDART AIRCRAFT RADIO CO.
6644-C SANTA MONICA BLVD., HOLLYWOOD 38, CALIFORNIA
Hollywood 4-9294

MEMBERSHIP

(*Continued from page 102A*)

Crabb, R. C., 1052 W. Sixth St., Los Angeles 17, Calif.
Dawkins, L. L., WPTF Insurance Bldg., Raleigh, N. C.
Dawson, L. R., 432 A Kalama St., Lanikai, T. H.
Debel, C. A., 3250 E. Almeria Rd., Phoenix, Ariz.
Dorschug, H. A., Radio Station WEEI, 182 Tremont St., Boston 11, Mass.
Ecklund, E. E., 119 Ridge Ave., Park Ridge, N. J.
Edwards, C. M., 4150 Seminole Dr., Royal Oak, Mich.
Enslein, K., Cyclotron Laboratory, University of Rochester, River Campus, Rochester 3, N. Y.
Flackbert, A. C., 30 Foster Pl., Sea Cliff, L. I., N. Y.
Fockler, W. G., 78 Chestnut Dr., Packanack Lake, N. J.
Goddard, E. G., Box 234, Oleada Rd., Pebble Beach, Calif.
Hammond, J. G., 302 S. Hilton Ave., Baltimore 28, Md.
Harp, C. E., 524 Macy, Norman, Okla.
Hensel, W. G., 265 Washington Ave., Chatham, N. J.
Jones, L. E., 1275 Indian Hill Blvd., Claremont, Calif.
Keener, C. E., 404 Wischman Ave., Oreland, Pa.
Kimball, E. W., 6277 S. W. 11 St., Miami 44, Fla.
Kiser, W. L., 74 Hendrick Ave., Glen Cove, L. I., N. Y.
Kovasznay, L. S. G., Department of Aeronautics, Johns Hopkins University, Baltimore 18, Md.
Kuehne, W., Collins Radio Co., 1937 Irving Blvd., Dallas 2, Tex.
Lawson, S. A., 4318 Shenandoah Dr., Dayton 7, Ohio
Mechler, E. A., 52 Wesley Ave., Erlton, N. J.
Miller, S. E., Box 188, King's Hgwy., Middletown, N. J.
Morse, W. R., 5009 Calvert Rd., College Park, Md.
Mueller, C. W., 1401 S. W. 56 St., Oklahoma City 8, Okla.
Mutter, W. E., International Business Machines Corp., Poughkeepsie, N. Y.
O'Brien, R. S., Columbia Broadcasting System, Inc., 485 Madison Ave., New York 22, N. Y.
Parker, H. W., 788 Kennesaw Way, Smyrna, Ga.
Perry, F. M., 2000 Pyle Rd., Schenectady 3, N. Y.
Rae, J. R., 171 Riverview Ave., Tarrytown, N. Y.
Rolf, W. R., 364 E. Fifth, Emporium, Pa.
Sherwood, H. R., ITTAG, MSA/G, APO 206, c/o PM, New York, N. Y.
Smith, R. L., 250 Sidney St., Belleville, Ont., Canada
Steber, W. C., Sperry Gyroscope Co., Great Neck, L. I., N. Y.
Steinman, B., 150 W. 21 St., New York 11, N. Y.
Thompson, R. R., Box 801, Tulsa, Okla.
Townley, R. K., Bell Telephone Laboratories, Inc., Murray Hill, N. J.
Van Rensselaer, C., 872 Parma Ave., Los Altos, Calif.
Vieweger, A. L., 45 Lakeview Ave., Long Branch, N. J.
Warsher, A., R. R. 2, 902 Norgate Dr., Ridgewood, N. J.
Whyman, E. W., 375 Mt. Vernon Rd., Snyder 21, N. Y.
Willis, H. W., 500 S. Rotherwood, Evansville 14, Ind.
Wong, M. S., 123 Ridge Ave., Dayton 5, Ohio
Woodmansee, B. S., Bell Telephone Laboratories, Inc., Murray Hill, N. J.
Young, G. O., 5319 W. 123 St., Hawthorne, Calif.

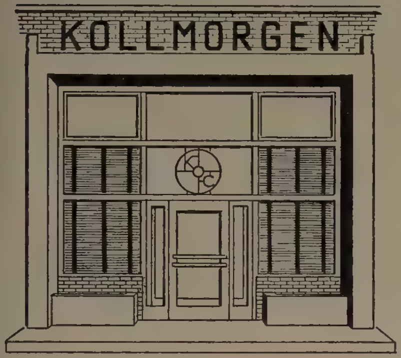
Admission to Senior Member

Barker, C. B., Jr., 1165 Via de la Paz, Pacific Palisades, Calif.

(*Continued on page 106A*)

OPTICAL SYSTEMS

INDUSTRIAL PERISCOPES



DESIGN

DEVELOPMENT

MANUFACTURE

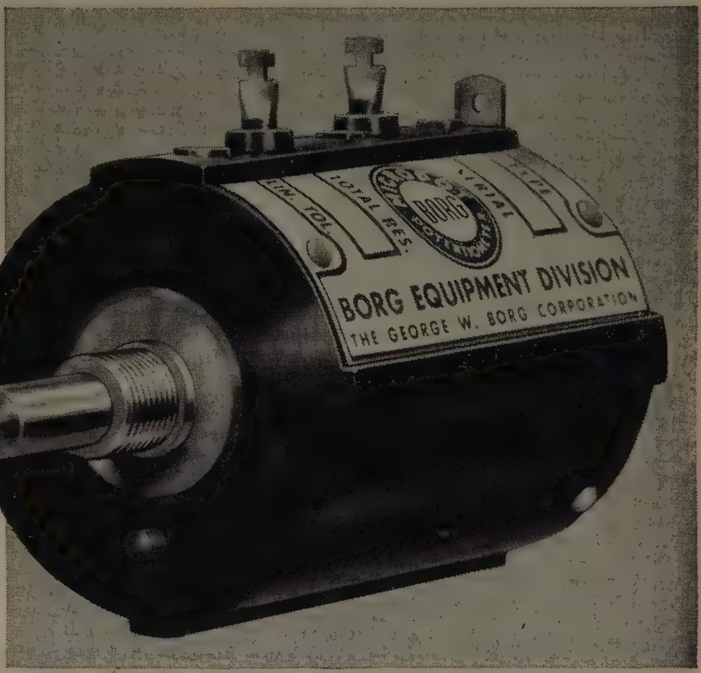
For nearly half a century Kollmorgen has designed, developed and manufactured precision optics and optical systems for industry and the military.

We have the engineering "know-how", the design personnel and the manufacturing capacity to help you solve your optical problem.

KOLLMORGEN *Optical* CORPORATION

Plant: 347 King Street • Northampton, Mass.
New York Office
30 Church Street
New York 7, N. Y.

THE HIGH-PRECISION LINEAR POTENTIOMETER



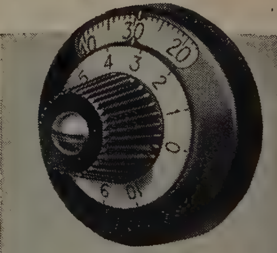
MICROPOT

precision ten-turn potentiometer

BORG MICROPOT TEN-TURN POTENTIOMETER: Built to fit the specifications of control system engineers and designers . . . constructed with Micro accuracy for precise voltage adjustments . . . featuring an assembly scientifically designed, machined, assembled and automatically machine tested for linearity of ±0.1% and 0.05%, *zero-based*. MICROPOTS ARE AVAILABLE IN 1.15 to 3 OHM and 30 to 250,000 OHM RANGES FOR IMMEDIATE SHIPMENT.

BORG MICRODIAL: Two concentrically mounted dials: one for counting increments of each turn and the other for counting turns . . . delivered completely assembled with dials synchronized. Outstanding features include smooth, uniform action . . . no backlash between incremental dial and potentiometer contact . . . less wear, only one moving part aside from the two dials . . . contact position indicated to an indexed accuracy of 1 part in 1,000.

MICROPOT-MICRODIAL CATALOG SENT PROMPTLY ON REQUEST



BORG MICRODIAL 746-A

A precision ten-turn indicating dial assembly. Has screw locking device on operating knob.

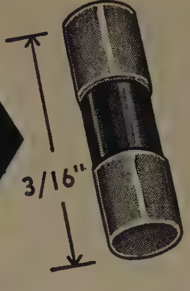
BORG MICRODIAL 746-B

Same as 746-A but has knurled locking screw mounted externally to operating knob.

BORG EQUIPMENT DIVISION
THE GEORGE W. BORG CORPORATION
Janesville • Wisconsin

MICROWAVE RESISTORS
TELEWAVE TYPE R

SMALLEST RESISTOR AVAILABLE
(Ideal for Miniaturization)



TYPICAL APPLICATIONS
- Power measurement at any frequency
- Matched terminations for waveguides or coaxial lines
- Resistive power pickup loops
- RF pads or attenuators
- Dummy loads
- Temperature measurements
- Impedance matching

TYPE R RESISTORS employ noble metal film deposits on specially selected heat resistant glass.

FILM THICKNESS offers negligible skin effect, at microwave frequencies.

POWER CAPACITY of 1/4 watt provides high power handling ability.

PHYSICAL STRUCTURE is ideally suited to impedance matching in standard coaxial line and waveguides.

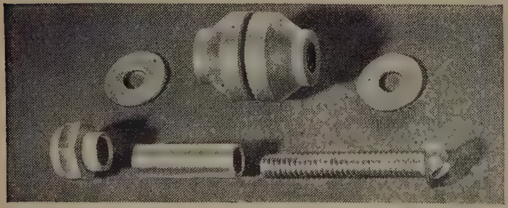
FINISH. Coated with a special silicone varnish to protect the film.

SPECIFICATIONS
Resistance: 50 ohms standard, other values on request.
Tolerance: 5% or 10%
Wattage: 1/4 watt continuous duty at 25°C
Size: 1/16 inch diam. x 3/16 inch long
Terminals: Tinned sections 1/16 inch long
Film Length: Type R-063 — 1/16 inch
Type R-093 — 3/32 inch
Temperature Coefficient: approx. 0.0019 ohms/ohm/°C.
Power Sensitivity: Approx. 10 ohms/watt

AVAILABLE FOR IMMEDIATE DELIVERY

TELEWAVE LABORATORIES, INC.
100 Metropolitan Ave. • Brooklyn 11, New York

Try Remler for Service-Tested "Hard-to-Get" Components



SILASTIC RUBBER SHOCK MOUNTS

① Ideal for sub-panel mounting. Isolates tubes from shock and vibration. Mount retains compliance from *minus* 70° to *plus* 480°F. Invaluable for military and airborne equipment.

Custom Components
Metal-plastic components designed and manufactured to order. Write for quotations specifying electrical and mechanical characteristics. Describe application. No obligation.

MINIATURE TUBE CLAMP

② Corrosion resistant. Holds miniatures in sockets under severe conditions of shock and vibration without restricting air circulation. Easy to insert and withdraw tubes. Three sizes.

Remler Company Ltd.
2101 Bryant St. San Francisco 10, Calif.

Remler
Since 1918 PIONEERS IN ELECTRONICS AND PLASTICS

MEMBERSHIP

(Continued from page 104A)

Bidwell, C. H., 724 Lafayette Dr., N.E., Albuquerque, N. M.
Boland, E. J., Carol Electronics Corp., 141 E. 2 St., New York, N. Y.
Burris-Mayer, H., Stevens Institute of Technology, Hoboken, N. J.
Caruthers, R. S., 455 Oregon Ave., Palo Alto, Calif.
Chang, S. S. L., 2440 Sedgwick Ave., New York 68, N. Y.
Cheston, T. C., 219 Charlton Ave., W., Hamilton, Ont., Canada
Fein, M. J., 5414 Arlington Ave., Riverdale 71, N. Y.
Foster, R. M., 265 S. Harrison St., E. Orange, N. J.
Gerwin, H. L., 9308 Adelaide Dr., Bethesda, Md.
Hermelin, L. S., 1138 E. 12 St., Brooklyn 30, N. Y.
Jaffe, H., 3311 Perkins Ave., Cleveland 14, Ohio
Kuhn, A. S., 25 E. 86 St., New York 28, N. Y.
Lang, L. M., 52 Forrest Ave., Fair Haven, N. J.
Lempert, J., Westinghouse Electric Corp., Elmira, N. Y.
Leng, R. B., Sylvania Electric Products, Inc., 500 Evelyn Ave., Mountain View, Calif.
Loda, C. J., 48 Center St., New London, Conn.
McConnell, J. H., Electro-Sonic Laboratories, Inc., 32-15—36 Ave., Long Island City 1, N. Y.
Mead, O. J., Jr., 553 Foxhall Pl., S.E., Washington 20, D. C.
Newton, I. T., Jr., Apt. 120A, Wallworth Park Apts., Haddonfield, N. J.
Omi, H., 1150 Kugahara, Otaku, Tokyo, Japan
Pakala, W. E., 222 Cascade Rd., Pittsburgh 21, Pa.
Paradise, M. E., National Fabricated Products, Inc., 2650 W. Belden Ave., Chicago 47, Ill.
Parry, C. A., 3721 Dupuis Ave., Montreal, Que., Canada
Prichard, A. C., 19 Alpern Ave., Elberon, N. J.
Pryslak, N. E., 14 Afton Dr., Florham Park, N. J.
Rabier, J. L., 4707 W. 19, Cicero, Ill.
Shepherd, M., Jr.. Texas Instruments, Inc., 6000 Lemmon Ave., Dallas 9, Tex.
Sturm, P. J., 2309 Calvert St., N.W., Washington 8, D. C.
Sullivan, R. J., 29 McAlester Ave., Hicksville, L. I., N. Y.
Teal, G. K., Texas Instruments, Inc., 6000 Lemmon Ave., Dallas, Tex.
Von Baeyer, H. J., 133 Sunnyside Ave., Ottawa, Ont., Canada
Wenger, L. S., American Embassy, USCGC Courier, APO 206, c/o PM, New York, N. Y.
Whealy, J. E., 3 Apple Tree Lane, Glen Cove, L. I., N. Y.
Wunderlich, G. F., 1428 Carlos Ave., Burlingame, Calif.

Transfer to Member

Alexander, J. E., E. I. Du Pont Co., Sabine River Works, Orange, Tex.
Armstrong, R. W., Box 95, Neptune, N. J.
Barsis, A. P., 3022 W. Kiowa, Colorado Springs, Colo.
Bristol, H. B., 20 Boulder Brook Rd., Wellesley 81, Mass.
da Rosa, A. W. V., Instituto Technologico de Aeronautica, Sao Jose Dos Campos, S. P., Brazil
Dudley, H. J., 2181 Old Shell Rd., Mobile, Ala.
Ettlinger, A. B., 30 Fifth Ave., New York 11, N. Y.
Farrell, R. L., I.A. (Pak) Ltd., David Sassoon Bldg., McLeod Rd., Karachi 2, Pakistan
Filman, N. J., 238 S. Ave., 51, Los Angeles 42, Calif.
Greenwood, H. M., 4914 Ventura Lane, Houston 21, Tex.
Hammer, F. E., Oklahoma City University, Oklahoma City, Okla.
Hepburn, J. T., 864 General Currie Rd., Vancouver 14, B. C., Canada
Howell, J. E., 604 Carthage Rd., Lumberton, N. C.
Iler, G. W., 228 Oak St., Lancaster, Ohio

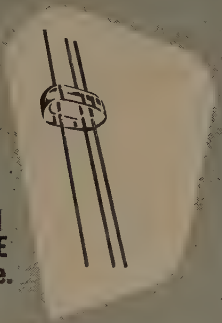
(Continued on page 108A)

TRANSISTORS

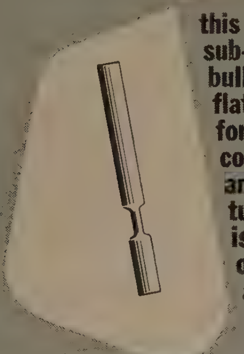
hermetically sealed in glass and evacuated

Recent developments have demonstrated that transistors must be sealed hermetically in glass and evacuated to protect them from the effects of heat, humidity, contamination, corrosion.

Only KAHLE Equipment provides automatic means for producing dependable Transistors hermetically sealed in glass and evacuated . . . at high production . . . at low cost . . . and in sub-miniature dimensions.



this sub-miniature button stem is produced on a KAHLE machine.



this sub-miniature bulb, flattened, formed, constricted and tubulated is produced on a KAHLE machine.

Kahle also produces the automatic Sealing and Exhaust Equipment as well as the automatic Welding Equipment for producing the transistor components.

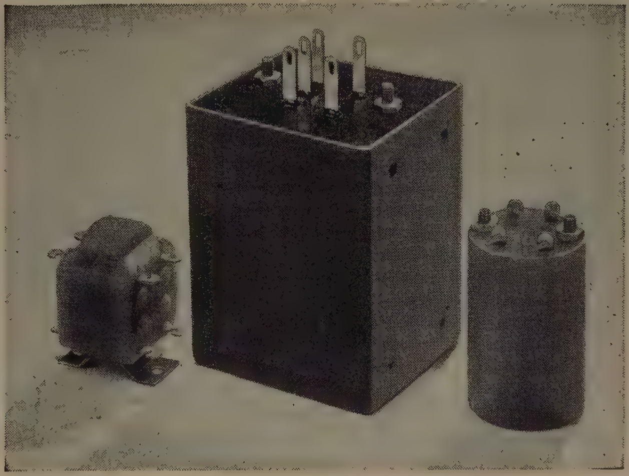
Write Kahle today for full information.

Kahle

ENGINEERING COMPANY
1312 SEVENTH STREET
NORTH BERGEN, N. J.

Kenyon

SPECIAL Transformers Have Many Applications



"Ken-Seal" Molded Units

There are many transformer applications in which hermetic sealing can be achieved more desirably than with metal casings. This is especially true where weight, space and cost are important factors. To satisfy this demand Kenyon has introduced "Ken-Seal" molded transformers which meet all government specifications. The molded process was chosen in preference to dipping or encapsulation because it produces a finished product of controllable, definite dimensions, with a uniform amount of sealing thickness.

An easily mixed casting resin is used, with cast separable molds for large production or small strippable molds for smaller quantities. This simple process insures uniformity and efficient sealing at low cost. "Ken-Seal" molded units may be the answer to some of your transformer problems. Send us your inquiries. We're in production now.

No matter what your transformer requirements may be contact Kenyon first. Our engineers will endeavor to show you how you can increase efficiency at low cost by choosing a transformer from the complete Kenyon line.

KENYON TRANSFORMER CO., Inc.

840 Barry Street, New York 59, N. Y.

POLYPENCO® 2-PART SERVICE...

to help designers gain the full benefits of TEFLON*

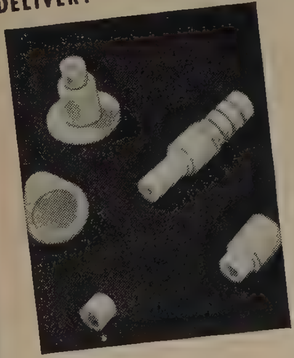
1.

TECHNICAL HELP ON APPLICATIONS AND FABRICATION

Polypenco controlled-quality Teflon resulted from Polymer's pioneering in the field of extruded industrial plastics. And ever since, Polymer engineers have more than kept pace with the newest ideas and methods to make the application and fabrication of POLYPENCO Teflon easier, more economical. The benefits of technical data, application and field experience and field engineering service are yours for the asking.

2.

DELIVERY OF EXTRUDED SHAPES, MACHINED AND MOLDED PARTS



In addition to complete stocks of POLYPENCO Teflon rod, strip and tubing, Polymer offers you quick delivery of controlled-quality Teflon parts machined or molded to your specifications. Take advantage of our years of experience spent working with designers in all the important electronic, electrical and mechanical fields.

*registered trademark of the Du Pont Company

mail now!

SEND ME THE FACTS...

...on Polypenco Teflon—how it is applied ☐
—prices on shapes available ☐

NAME_____ TITLE_____
COMPANY_____
ADDRESS_____
CITY_____ ZONE_____ STATE_____

The POLYMER CORPORATION of Penna., Reading, Penna.

MEMBERSHIP

(Continued from page 106A)

Johnson, M. W., 1141 W. 91 St., Los Angeles 44, Calif.
Karp, A., Bell Telephone Laboratories, Inc., Box 107, Red Bank, N. J.
Klein, R. C., 41 Edwards St., Roslyn Heights, L. I., N. Y.
Knochel, W. J., Westinghouse Electric Corp., Box 284, Elmira, N. Y.
Miller, R. E., 2087 Williams St., Palo Alto, Calif.
Moore, E. J., Neely Enterprises, 1029 Rosecrans St., San Diego, Calif.
Pueschner, H. O., Philco Tech Rep, c/o DM Hq. EADF, Stewart AFB, Newburgh, N. Y.
Sarkar, N., 15 Springfield Park Rd., Chelmsford, Essex, England
Segal, B., 1113 Cobbs St., Drexel Hill, Pa.
Shelor, E. G., Jr., 628 Woodbine Ave., Towson 4, Md.
Sherman, E. H., 42 Boulder Lane, Levittown, L. I., N. Y.
Spence, D. W., 111 Alexander St., Schenectady, N. Y.
Stewart, C. H., II, 4321 S. 35 St., Arlington, Va.
Stouch, D. H., 5029 Sutton Ave., Dayton, Ohio
Urman, B. S., 8798 Colbath Ave., Van Nuys, Calif.
Ward, B. R., 185 E. 159 St., New York 51, N. Y.
Yachimec, P., 204 Oakwood Ave., Toronto, Ont., Canada
Weisz, W. J., 8710 N. Hamlin Ave., Skokie, Ill.

Admission to Member

Ahmad, M. D., Officers Mess, RPAF, Mauripur, Karachi, Pakistan
Barkalow, D. E., 243 E. Ute Pl., Tulsa 6, Okla.
Benjamin, F., 17–23 Jordan Rd., Fair Lawn, N. J.
Best, F. G., 3358 Vassar, Dearborn 8, Mich.
Biggs, E. M., Jr., 296 Wellington Rd., Mineola, L. I., N. Y.
Bixler, D. A., 1963 Haworth St., Philadelphia 24, Pa.
Booth, R. C., Electric Eye Equipment Co., 6 W. Fairchild, Danville, Ill.
Boxer, V., 227—14 Ave., Belmar, N. J.
Brown, L. W., 70 Strathmore Rd., Brighton, 46, Mass.
Cleary, R. E., Box 8744 "B," Wright-Patterson AFB, Ohio
Cook, E. E., 5829 Gross Dr., Dayton 3, Ohio
Day, L. R., 16 Vesta Rd., Natick, Mass.
Dubbs, W. M., 5113 Walker Way, El Paso, Tex.
Dunlap, M. E., 548 S. Lorraine Ave., Wichita 16, Kans.
Elliott, G., 3556 Grey Ave., N.D.G., Montreal, Que., Canada
Falcon, G. L., 54 Greenways, Standish, Nr. Wigan, Lancashire, England
Giori, F. A., 76 Pilgrim Rd., Tonawanda, N. Y.
Goldhaber, J. C., 1427 S. Drake Ave., Chicago 23, Ill.
Gooday, R. A. H., 75 Childwall Priory Rd., Childwall, Liverpool, England
Green, H. H., 13 Lower Woods Rd., New Hartford, N. Y.
Gros, J. R., Dahlgren, Va.
Hart, M. T., 527 Porter Ave., Fullerton, Calif.
Hartmann, Z., 17 Dahlia Ave., Baldwin, L. I., N. Y.
Hempy, R. L., 935 N. Gibbs, Pomona, Calif.
Henkels, H. W., Moore School of Electrical Engineering, University of Pennsylvania, 33 and Walnut Sts., Philadelphia, Pa.
Hofeld, J. G., 3626 E. 34 St., Indianapolis 18, Ind.
Hughes, J. K., 49 Teignmouth Ave., Toronto 10, Ont., Canada
Jarmain, E. R., 13 King St., London, Ont., Canada
Jenkins, K. A., 1801 N. Roff, Oklahoma City 7, Okla.
Kafitz, P. H., 1430 Mills Ct., Menlo Park, Calif.
Kaspin, S., 5812 Daneland St., Long Beach 11, Calif.
Katz, G. M., 805 St. Marks Ave., Brooklyn, N. Y.

(Continued on page 112A)

IRE's 21 Professional Groups

Communications Systems

Radio and wire telephone, telegraph and facsimile in marine, aeronautical, radio-relay, coaxial cable and fixed station services.

Mr. George T. Royden, Chairman, Mackay Radio & Telephone Co., 67 Broad Street, New York 4, N.Y.

Fee $2. New Group.

Component Parts

The characteristics, limitations, applications, development, performance and reliability of component parts.

Mr. Floyd A. Paul, Chairman, Supervisor, Electronic Reliability Sec., Dept. 3230, Northrup Aircraft, Inc., Hawthorne, Calif.

Fee not yet established.

Electron Devices

Electron devices, including particularly electron tubes and solid state devices.

Mr. G. D. O'Neill, Chairman, Sylvania Electric Products, Inc., Sylvania Center, Bayside, Long Island, N.Y.

Fee $2. Transactions *1 and *2

Electronic Computers

Design and operation of electronic computers.

Dr. M. M. Astrahan, Chairman, International Business Machine Laboratories, Poughkeepsie, N.Y.

Fee $2. Transactions *1, *2, **3

Engineering Management

Engineering management and administration as applied to technical, industrial and educational activities in the field of electronics.

Mr. Ralph I. Cole, Chairman, Melpar Incorporated, 452 Swann Avenue, Alexandria, Va.

Fee $1. **Convention Report

Industrial Electronics

Electronics pertaining to control, treatment and measurement, specifically in industrial processes.

Mr. Eugene Mittelmann, Chairman, 549 Washington Ave., Chicago 6, Ill.

Fee $2. **Convention Report

Information Theory

Information theory and its application in radio circuitry and systems.

Mr. Nathan Marchand, Chairman, Marchand Electronics Laboratory, Greenwich, Conn.

Fee $2. Transaction *1.

Instrumentation

Measurements and instrumentation utilizing electronic techniques.

Mr. Ivan G. Easton, Chairman, General Radio Co., 275 Massachusetts Ave., Cambridge 39, Mass.

Fee $1. Transactions 1, **2. **Convention Report

Medical Electronics

The application of electronics engineering to the problems of the medical profession.

Mr. L. H. Mongomery, Jr., Chairman, Vanderbilt University Sch. of Medicine, Nashville, Tenn.

Fee $1. **Convention Report

Microwave Theory and Techniques

Microwave theory, microwave circuitry and techniques, microwave measurements and the generation and amplification of microwaves.

Mr. Ben Warriner, Chairman, General Electric Co., Advanced Electronics Center, Ithaca, N.Y.

Fee $2. *Vol. MTT-1, #1

Nuclear Science

Application of electronic techniques and devices to the nuclear field.

Dr. J. P. H. Kuper, Acting Chairman, Brookhaven National Laboratories, Upton, L.I., N.Y.

No fee established yet.

Quality Control

Techniques of determining and controlling the quality of electronic parts and equipment during their manufacture.

Mr. Leon Bass, Chairman, General Electric Co., Syracuse, N.Y.

Fee $2. Transactions *1, *2

Radio Telemetry and Remote Control

The control of devices and the measurement and recording of data from a remote point by radio.

Mr. Martin V. Kiebert, Jr., Chairman, Bendix Aviation Corp., Teterboro, N.J.

Fee $1. **Convention Report

Vehicular Communications

Communications problems in the field of land and mobile radio services, such as public safety, public utilities, railroads, commercial land transportation, etc.

Mr. Frederick T. Budelman, Budelman Radio Corp., 375 Fairfield Ave., Stamford, Conn.

Fee $2. Transactions 1, *2, **3

Ultrasonics Engineering

Ultrasonic measurements and communications, including underwater sound, ultrasonic delay lines, and various chemical and industrial ultrasonic devices.

Mr. A. L. Lane, Chairman, Naval Ordnance Lab. Rm. 4-133 White Oak, Silver Spring, Md.

No fee established yet.

ENGINEERS 1 East 79th Street, New York 21, N. Y.

MEET THE EXACTING DEMANDS OF

transistor circuitry

specify

SANGAMO TYPE EHT
TANTALUM CAPACITORS

The Sangamo Type EHT tantalum foil electrolytic capacitor has been designed for use in audio-frequency transistor circuits, such as hearing aids and advanced equipment for defense.

Since the Type EHT is much smaller and lighter in weight than oil or wax impregnated paper coupling capacitors, it is a valuable tool that helps the electronic designer realize the inherent transistor advantages of miniaturization.

The Sangamo EHT capacitor uses electrodes of high purity tantalum foil. These electrodes provide greater capacitance per unit volume than aluminum electrode units of similar construction.

Both the cathode and anode lead wires are securely welded to the foils for maximum electrical contact dependency.

Greater life expectancy is inherent in the Sangamo EHT because of the more stable oxide film and the extremely inert characteristic of tantalum.

Write for Engineering Data Sheet EHT for full information.

Those who know...choose Sangamo

the Little Indian

SANGAMO ELECTRIC CO. MARION, ILLINOIS

MEMBERSHIP

(Continued from page 108A)

Lambert, C. R., 704 Center Ave., Clarks Summit, Pa.
Levy, S. L., Box 63, Harristown, Ill.
Long, T. G., 75 Albert St., Aylmer, E., Que., Canada
Lohman, R. D., RCA Laboratories, Princeton, N. J.
Malcolm, F. W., 3 Cherrier St., St. Paul l'Ermite, Que., Canada
McAdie, C. H., 3643 Forest Hill Rd., Baltimore 7, Md.
McCool, C. D., 2125 York St., Owensboro, Ky.
McDaniel, F., Radio Station WRAD, Radford, Va.
McDuffie, G. E., Jr., 12707 Valleywood Dr., Silver Spring, Md.
McGee, J. W., 3433 Northwood Ave., Toledo 10, Ohio
McMillan, R. E., 1067 San Pasqual St., Pasadena 5, Calif.
Mead, H. W., N. 2508 Magnolia, Spokane 26, Wash.
Melville, R. W., Electronic Computer Project, Princeton, N. J.
Meyer, H. E., Jr., 83 Eakins Rd., Manhasset, N. Y.
Meyer, J. H., 1930 Prince St., Berkeley 3, Calif.
Moroze, M. W., Hq. AACS, D/Engr., Andrews AFB, Washington 25, D. C.
Nevins, J. E., Jr., Bldg. 119, Stanford Village, Stanford, Calif.
Newman, A. W., 463 Highland Ave., Orange, N. J.
Nicol, R. A., 1505 N. Naomi, Burbank, Calif.
Raftree, L. K., The Hermaseal Co., Inc., Elkhart, Ind.
Reynolds, A. C., Jr., Development Laboratory, International Business Machines Corp., Endicott, N. Y.
Roberts, W. H., 58 Main St., Hudson Falls, N. Y.
Rogers, R. M., 20 W. Simpson St., Troy, Ohio
Rucki, D. H., 511—18 Ave., Newark 3, N. J.
Sarratt, E. R., 4316 E. 163 St., Cleveland, Ohio
Shaskey, E. N., 209A Donnybrook Lane, Towson 4, Md.
Stamps, G. M., 101 Campbell St., New Hyde Park, L. I., N. Y.
Storey, B., 5558 Boaz, Dallas, Tex.
Thornton, W. H., 3126 Bapaume Ave., Norfolk, Va.
Weir, W. R., 32-37—190 St., Flushing, L. I., N. Y.
Wheeler, J. L., 215 Oxford St., Rochester, N. Y.
Williams, G. W., 65-38 Parsons Blvd., Flushing, L. I., N. Y.
Witte, R., 1019 Aurora Way, Wheaton, Ill.
Yurko, M., 907 Glasgow Crescent, Manor Park, Ottawa, Ont., Canada
Zawels, J., 600 Lees Ave., Collingswood, N. J.

The following elections to Associate grade were approved to be effective as of May 1, 1953:

Addamo, J. H., 47-53 Delancey St., New York 2, N. Y.
Adlsberg, J., 2505 Olinville Ave., New York 67, N. Y.
Albanese, P., 157 Prospect Pl., Brooklyn 17, N. Y.
Aleks, E. J., Box 5, Middlefield, Conn.
Amdahl, G. M., 19 Flannery Ave., Poughkeepsie, N. Y.
Anderegg, J. S., Hodd Bldg., Massachusetts Institute of Technology, Cambridge 39, Mass.
Anderson, A. G., Watson Laboratory, 612 West 116 St., New York, N. Y.
Anderson, W. F., 1808 Wake St., Raleigh, N. C.
Andres, N. E., Jr., 116 Langdon Ave., Watertown, Mass.
Andrews, P. C., 2109-B Berkley Dr., Philadelphia 29, Pa.
Anker, R. W., AA & GM TAS, Box 72 (Philco), Fort Bliss, Tex.
Applequist, J. E., Watson Laboratory, 612 West 116 St., New York, N. Y.
Aron, M., Radio Receptor Co., 84 N. Ninth St., Brooklyn, N. Y.
Arrigo, L., Jr., 133 Huguenot Ave., Englewood, N. J.

(Continued on page 114A)

HEAT DISSIPATING CONNECTORS

Vacuum Tube Accessories by Eimac —
Now Available!

Type HR heat dissipating connectors are designed to provide an efficient method of heat transfer from tube elements and seals to the air. Also facilitate electrical connection to plate or grid leads of most popular transmitting tube types. Machined from solid dural rod, come complete with necessary machine screws for use.

- *Write for new Eimac Catalogue Summary showing Eimac tubes and other accessories.*

Eimac

EITEL - McCULLOUGH, INC.
San Bruno, California

Measurements Corporation
MODEL 79-B

PULSE GENERATOR

REPETITION RATE: 60 to 100,000 pulses per second.

PULSE WIDTH: Continuously variable from 0.5 to 40 microseconds.

RISE TIME: Approx. 0.25 microseconds.

OUTPUT VOLTAGE: 150 volts (peak) positive.

POWER SUPPLY: 117 volts, 50/60 cycles.

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY

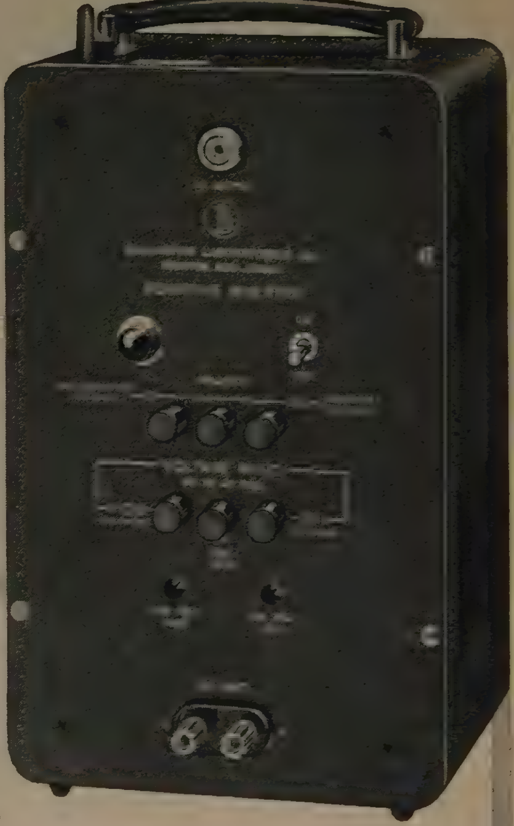
New BALLANTINE SENSITIVE INVERTER

for the precise measurement of small DC potentials

from
10μv — 100v

Threshold Sensitivity
1 μv

FOR USE WITH
Vacuum Tube Voltmeters
Oscilloscopes
Voltage Amplifiers
Multimeters
Servo-Amplifiers



MODEL 700

FEATURES

- Built-in Calibrator
- High Sensitivity
- High Input Resistance
- Distortion-free Output
- Low Noise Level
- Accurate for 50-70 cps Line Frequencies
- Polarity Sensing
- Immune to 60 cps Stray Magnetic Fields

SPECIFICATIONS—MODEL 700

INPUT VOLTAGE RANGE	10 μv—100 v DC (Sensitive to 1 μv)
VOLTAGE RATIOS (DC input to AC RMS output)	1:100 & 10:1
INVERSION STABILITY (>100 μv input)	1%
CALIBRATOR ACCURACY	0.25%
DC INPUT RESISTANCE	10 meg for 1:100; 50 meg for 10:1
AC INPUT IMPEDANCE	>200k
INPUT NOISE LEVEL	Approx. 3 μv
AC OUTPUT FREQUENCY	Line Frequency
MAX AC OUTPUT LEVEL	10 v RMS
TOTAL DISTORTION IN OUTPUT WAVE FORM	<2%
RESPONSE TIME (90% of Final Amplitude)	0.25%
POWER REQUIREMENTS	105-125 v; 50-70 cps; 15 watts

BALLANTINE LABORATORIES, INC.
102 Fanny Road, Boonton, N.J.

when better SYNCHROS are required SPECIFY *Telesyn*

FORD

- Proved Precision Accuracy
- Meet Government Specifications
- Corrosion Resistance
- Fungus Resistance
- Available in wide selection of sizes

WRITE FOR NEW TELESYN BROCHURE

FORD INSTRUMENT COMPANY

Division of the Sperry Corporation
31-10 Thomson Avenue
Long Island City 1, N. Y.

New 800-2600 mcs FREQUENCY METERS
Lightweight — Portable Units

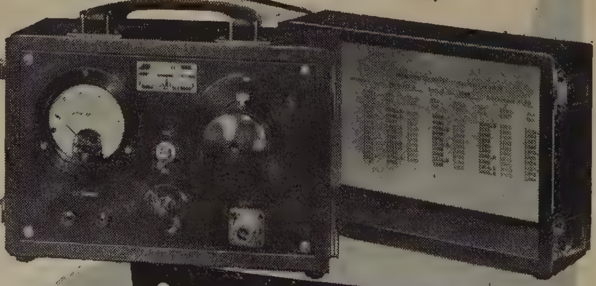
...For Field and Laboratory Use!

SPECIFICATIONS

1. **ACCURACY**
   Better than .05% from 20°F to 120°F
2. **SENSITIVITY**
   Usable indication with 1 milliwatt input
   Adjustable for higher levels
3. **INDICATOR**
   50 Microammeter
4. **INPUT**
   50 Ohm Type N Connector
5. **EXTERNAL DC OUTPUT**
   Pin Jacks
6. **EXCURSION OF MICROMETER**
   One-half inch
7. **MICROMETER SCALE**
   at 1000 Mc —
   1 Division equals 290 KC
   at 1400 Mc —
   1 Division equals 350 KC
   at 2000 Mc —
   1 Division equals 450 KC
   at 2600 Mc —
   1 Division equals 555 KC
8. **EXTERNAL SIZE**
   6½ x 9¾ x 7"
9. **WEIGHT**
   Four pounds

Models
FS-C-171-A 800-1200 MCS.
FS-C-172-A 1200-1600 MCS.
FS-C-173-A 1600-2250 MCS.
FS-C-174-A 1700-2600 MCS.

Units consist of cavity body, micrometer control, crystal, suitable connectors and calibration chart. Write for specifications and prices.



(Cavity units are also available for custom housing)

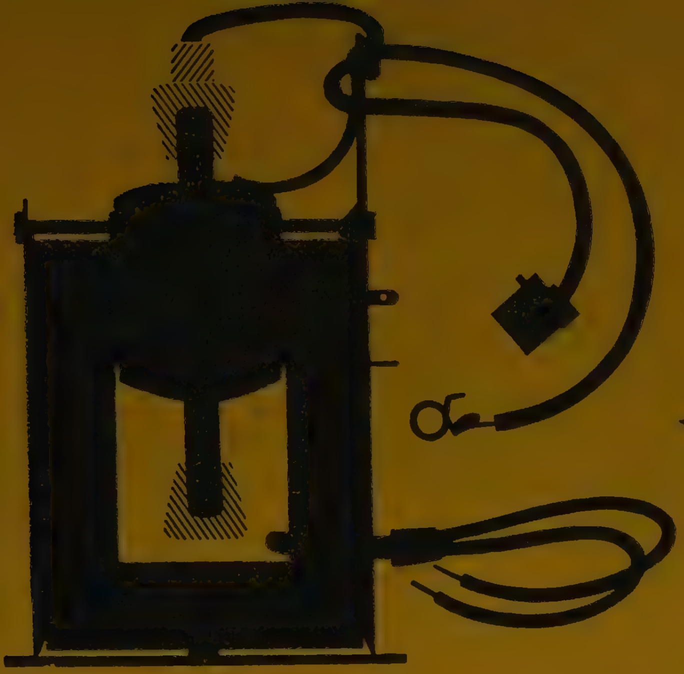
frequency standards
P. O. Box 504
Asbury Park, New Jersey

MEMBERSHIP

(Continued from page 112A)

Auerbach, L., 152–13 Roosevelt Ave., Flushing L. I., N. Y.
Baker, R. R., Middletown Turnpike, Northford, Conn.
Ballard, L. L., 2387 Fifth St., East Meadow, L. I., N. Y.
Barber, R. G., 20 Chadwick St., Glen Cove, L. I., N. Y.
Barnett, J. E., 1905 N. E. 25, Oklahoma City, Okla.
Bartels, R. H., 410 Prospect St., Apt. 11-G, East Orange, N. J.
Beaulieu, A. J., 10321 Cresthoor Dr., Silver Spring, Md.
Berg, A., 482 Amsterdam Ave., New York 24, N. Y.
Bergstein, L. E., 535 Saratoga Ave., Brooklyn 12, N. Y.
Bernstein, F., 37 Peachtree La., Levittown, Pa.
Bet, D. V., 5104 N. Senasac, Long Beach 11, Calif.
Billets, M. P., 260 S. Orange Ave., South Orange, N. J.
Bledsoe, J. A., 6739 Robinson Blvd., Allen Park, Mich.
Blessing, R. R., International Business Machines Corp., South Rd., Poughkeepsie, N. Y.
Boesch, A. H., Boesch Mfg. Co., Danbury, Conn.
Bosisio, R. G., 9590 Du Buisson St., Montreal, Que., Canada
Bradshaw, E. R., Jr., 84 Massachusetts Ave., Cambridge 39, Mass.
Brown, J. S., 5201 Timber Wolf Dr., El Paso, Tex.
Brown, J. R., R.F.D. 3, Candler, N. C.
Brown, V. L., 31 Sherman St., Jamesburg, N. J.
Brownstein, M., 201 S. Second St., Brooklyn 11, N. Y.
Brunswick, H. D., 6329 Jeff St., San Diego 15, Calif.
Bryant, J. A., 1905 Lewis La., Owensboro, Ky.
Bryson, R. W., United States Time Corp., Waterbury 91, Conn.
Buble, F. L., 259–09 E. Williston Ave., Floral Park, L. I., N. Y.
Butterfield, J. L., Box 990, Georgia Institute of Technology, Atlanta, Ga.
Byars, W. F., 2328 N. York St., Owensboro, Ky.
Callomon, R., 719 Merrill St., Corona, Calif.
Cammarata, J., 21 First Ave., New York 3, N. Y.
Campbell, S. S., 8901 Colesville Rd., Silver Spring, Md.
Canegallo, G., Via G. B. Grassi 97, Milano, Italy
Caprarola, L. J., 147 Lincoln Ave., Newark, N. J.
Caplan, L. N., Army Radio Station, Laplata, Md.
Carlson, A. W., 21 Ashland St., Arlington 74, Mass.
Carlson, D. A., 4207 N. Laramie Ave., Chicago 41, Ill.
Carlson, H. J., Office of Naval Research, 1000 Geary St., San Francisco, Calif.
Carlson, L. C., 127 Valentine St., Mount Vernon, N. Y.
Carter, W. F., 29 Morris St., New Rochelle, N. Y.
Ceres, G. V., 740 Lee St., Perth Amboy, N. J.
Child, A. A., 26 Old Glebe Rd., Arlington, Va.
Chiswell, E., Rosemount Research Center, Rosemount, Minn.
Chown, J. B., 1540 Waldran Ave., Los Angeles 41, Calif.
Christensen, B., 119 Terrace Dr., Pittsburgh 28, Pa.
Claborn, K. K., W. Joppa Rd., Riderwood, Md.
Clayton, G. H., 15371 Sorrento, Detroit 27, Mich.
Clerkin, C. R., 138–46 Northern Blvd., Flushing, L. I., N. Y.
Cohen, H. P., 32 Cherry St., Milford, Conn.
Cole, W. S., 534 E. Market St., York, Pa.
Collins, R. M., 48 S. Fifth St., Harrison, N. J.
Copp, J., Flat 3, 16 St. Aubyns, Hove, Sussex, England
Cord, C. E., 2055 Garland, Wichita 3, Kans.
Cordaro, C. F., Radio Station WKAP, Box 689, Allentown, Pa.
Coyne, J. M., Jr., Box 3075, USAFIT, Wright-Patterson AFB, Dayton, Ohio

(Continued on page 116A)



high voltage ARC INHIBITOR by Guthman

When TV manufacturers discovered that higher voltages of the new 27 and 21-inch television receivers rendered existing wax corona ring sweep transformers inadequate, they brought the problem to Guthman.

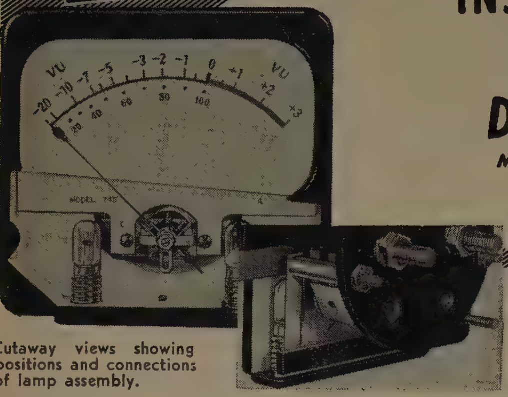
In a cooperative program with these TV engineers, a flyback transformer with a cast resin corona ring was developed—the perfect answer to this difficulty.

Your problems in the development of coils and transformers are welcome at *Edwin I. Guthman & Company, Inc.*, 15 South Throop St., Chicago 7, Telephone: CH 3-1600, also Attica, Indiana.

THEY HAD A PROBLEM...

Burlington

ILLUMINATED INSTRUMENT FOR VU-DB-DBM Measurement



Cutaway views showing positions and connections of lamp assembly.

Available in all ranges 3½" and 4¼" rectangular semi-flush models.

EXCELLENT LIGHT DISTRIBUTION affords EASE IN READING. GLARE REDUCED to a minimum by retaining COMPACT DESIGN of front case extension.

REFLECTED LIGHT PRINCIPLE permits use of standard METAL DIALS eliminating translucent materials that discolor with age and use.

BULB REPLACEMENT FACILITATED by removal of single lamp assembly.

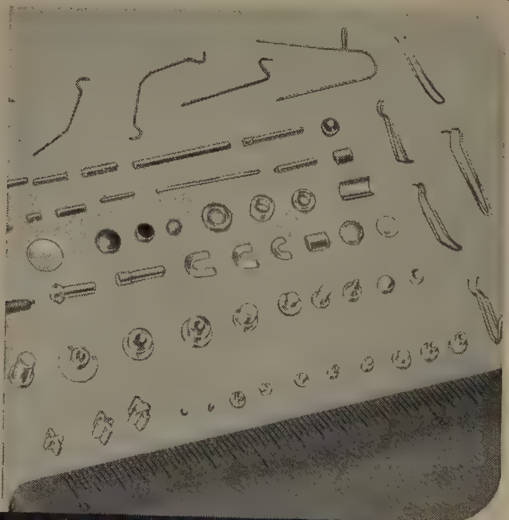
Two 3.8 volt STANDARD BULBS are used and connected in series.

Write Dept. I-63 for complete details

BURLINGTON INSTRUMENT COMPANY
DEPT. I-63, BURLINGTON, IOWA

NEY

PRECIOUS METAL ALLOYS AND COMPLETE ASSEMBLIES



IMPROVE INSTRUMENT PERFORMANCE

Paliney*#7, Ney-Oro G, Ney-Oro #28, and Ney #90 Alloy are precious metal alloys developed in the laboratories of the J. M. Ney Company for the fabrication of contacts, brushes, wipers, slip rings, commutator segments, and similar components used in precision control and instrumentation. Each alloy has specific qualities which mean greater accuracy and prolonged instrument life, as well as resistance to most corrosive industrial atmospheres.

Parts fabricated from Ney's Precious Metal Alloys are now components of instruments used in navigation, recording, computing, and many other devices. Consult the Ney Engineering Department for assistance with your problems.

*Reg. Trade Mark J. M. Ney Co.

THE J. M. NEY COMPANY • 171 Elm Street, Hartford 1, Conn.
Specialists in Precious Metal Metallurgy Since 1812

3NY53

MEMBERSHIP

(Continued from page 114A)

Crawford, J. K., Merry Hill, R.F.D. 2, Poughkeepsie, N. Y.
Cubert, J. S., 1407 Shakespeare Ave., New York 52, N. Y.
Currier, P. J., 2 Mass Court, Passaic, N. J.
Curtis, D. D., Box 92, Waynesboro, Va.
Dalessandro, J. A., 14–23—155 St., Beechhurst 57, L. I., N. Y.
Daly, J. J., 89–36—187 St., Hollis 23, L. I., N. Y.
Daly, J. A., Jr., Brookwood Garden Apts., Apt. 18-B, Burlington, N. C.
Davis, C. M., 41 Innis Ave., Poughkeepsie, N. Y.
Davisson, R. R., 19 Middle St., Waltham 54, Mass.
Day, S. M., Box 367, R.F.D. 1, Bay Shore, L. I., N. Y.
Dehart, J. E., 2013A Bluemont Dr., Greensboro, N. C.
Delitt, J. P., 5930 North 14 St., Arlington 5, Va.
Desirant, M. C., A.C.E.C., Charleroi, Belgium
Diambra, H. M., 707 Emerson St., N.E., Washington 17, D. C.
Dicarlo, V. J., 4094 Cabinet St., Pittsburgh 24, Pa.
Di Caudo, V., 472 E. Tallmadge Ave., Akron 10, Ohio
Dickson, W. H., Box 92, East Princeton, Mass.
Dinsmore, R. B., 4028 Huey Ave., Drexel Hill, Pa.
Domenico, R. J., Old Troy Rd., Wappingers Falls, N. Y.
Downes, A. B., 74 State St., Boston, Mass.
Droege, R. F., 7019 Marquette, St. Louis 9, Mo.
Dubrow, W., Box 234, Burlington, N. J.
Duggie, R. L., 7 Corbet St., Dorchester 24, Mass.
Dullinger, A. G., Jr., 7135 Greenwood Ave., Baltimore 6, Md.
Duncan, J. W., 3227—34 St., Apt. T, Sandia Base, Albuquerque, N. Mex.
Dunn, R. S., Collins Radio Co., Cedar Rapids 6, Iowa
Dycus, R. W., 2619 Lumina Ave., Charlotte, N. C.
Earle, N. E., Marion Ave., Groveland, Mass.
Edelman, F., 21 First St., Freehold, N. J.
Ess, A. J., Volkmarstrasse 9, Zurich, Switzerland
Evans, J., 108–10—65 Ave., Forest Hills, L. I., N. Y.
Evans, R. C., 110 S. Gay, Knoxville 24, Tenn.
Fair, E. G., Box 509, 6332 Maintenance Squadron, APO 239-1, c/o Postmaster, San Francisco Calif.
Farese, V. G., 475 South 11 St., Newark 3, N. J.
Farinet, F. A., Jr., 814½ N. Limestone, Springfield, Ohio
Farr, L. E., Jr., 816 Verna Dr., Vestal, N. Y.
Fath, J. P., 4925 N. Broad St., Philadelphia 41, Pa.
Fernandez-Rivas, L. A., Walnut Park, Plaza Hotel, Walnut at 63 St., Philadelphia 39, Pa.
Ferrier, J. M., Genreal Dry Batteries, 1300 Athens Ave., Cleveland, Ohio
Fishner, S., 56–26—229 St., Bayside, L. I., N. Y.
Fisler, R. E., 225 Baker Ave., St. Louis, Mo.
Fitzpatrick, J. J., 38 Prospect St., Ansonia, Conn.
Fleury, P. E., 17 Fairview Ave., Feasterville, Pa.
Forman, H. L., 310 Hillwood Dr., Akron 20, Ohio
Forster, E. E., 126 E. Pennywood Ave., Roosevelt, L. I., N. Y.
Francis, J. P., White Marsh, Md.
Franklin, W. S., 918 Grassmere Ave., Wanamassa, N. J.
Frear, R. B., Box 149, APO 919, c/o Postmaster, San Francisco, Calif.
Freeburger, B. P., 4113—18 St., N.E., Washington 18, D. C.
Fugate, K. O., Pleasant Run Rd., R.F.D. 2, Lancaster, Tex.
Gancie, J. J., 108 Central Ave., Brooklyn 6, N. Y.
Gardenhour, A. J., Jr., 12122 Centerhill St., Wheaton, Silver Spring, Md.
Gardner, R. W., 118 Paul St., Woodland View, York, Pa.
Gariano, W. F., 457—11 Ave., Paterson 4, N. J.
Garrahan, P. G., 15 Waldo Ave., Bloomfield, N. J.

(Continued on page 118A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 18A)

Closed Circuit TV Transmitter

Boxoffice Television, 255 W. 84 St., New York 24, N. Y., announces development of the TV Picturecaster, a closed-circuit transmitter for both aural and visual signals.

The TV Picturecaster accepts video and audio from any source, receiver, camera chain, coaxial line, or generator, and transmits them into any type of transmission line on any VHF channel, 2 through 13. The transmitter frequency is crystal-controlled, with the sound and video carriers automatically maintained $4\frac{1}{2}$ mc apart for best results with intercarrier receivers. AM pictures and FM sound are receivable on all standard TV receivers.

(Continued on page 142A)

ELECTRONICALLY REGULATED

LABORATORY POWER SUPPLIES

RACK MODEL 28

STABLE

DEPENDABLE

MODERATELY PRICED

MODEL 28
STANDARD RACK MOUNTING

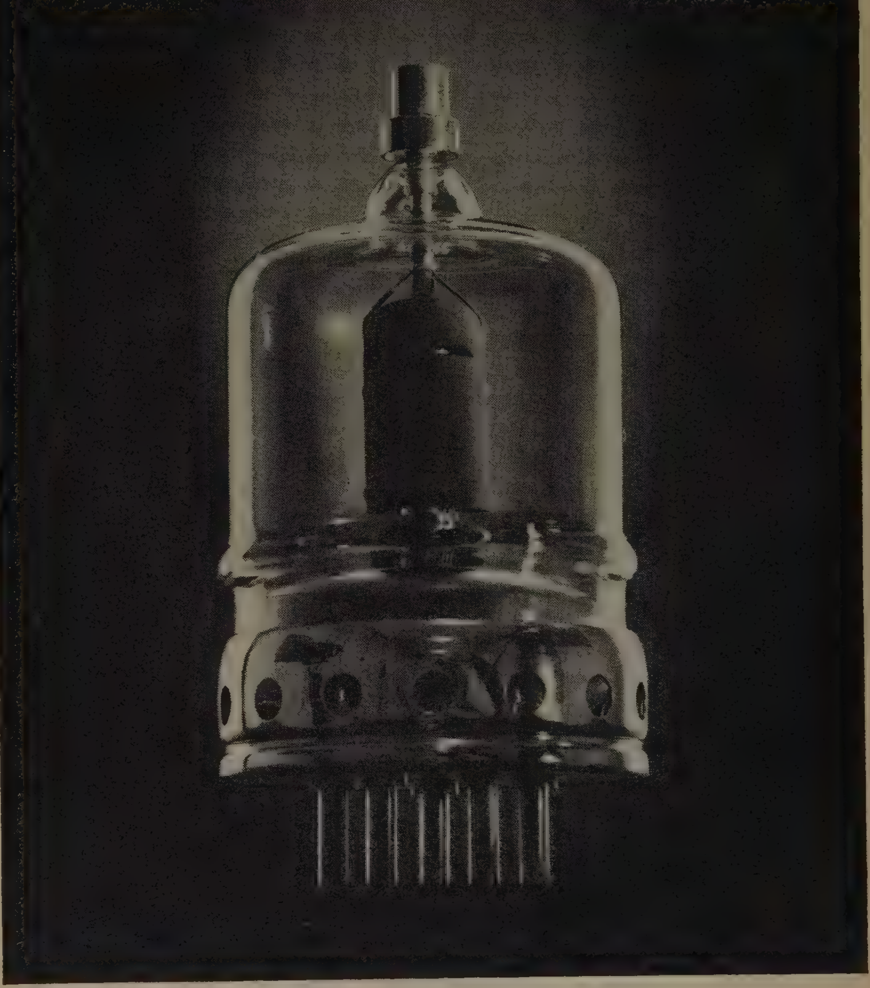
PANEL SIZE
5¼" x 19"
WEIGHT 16 LBS.

- **INPUT:** 105 to 125 VAC, 50-60 cy
- **OUTPUT #1:** 200 to 325 Volts DC at 100 ma regulated
- **OUTPUT #2:** 6.3 Volts AC CT at 3A unregulated
- **RIPPLE OUTPUT:** Less than 10 millivolts rms

For complete information write for Bulletin N-8S

LAMBDA ELECTRONICS
CORPORATION
CORONA NEW YORK

TIME-TRIED TETRODE



LOS GATOS 4D21/4-125A

MODERN in every respect—with exclusive Sintercote black-body high-dissipation anode and emission-free grids—the Los Gatos 4D21/4-125A provides a new source of supply for a widely-applied tetrode type. Check Los Gatos for your requirements in other types with emphasis on long service life.

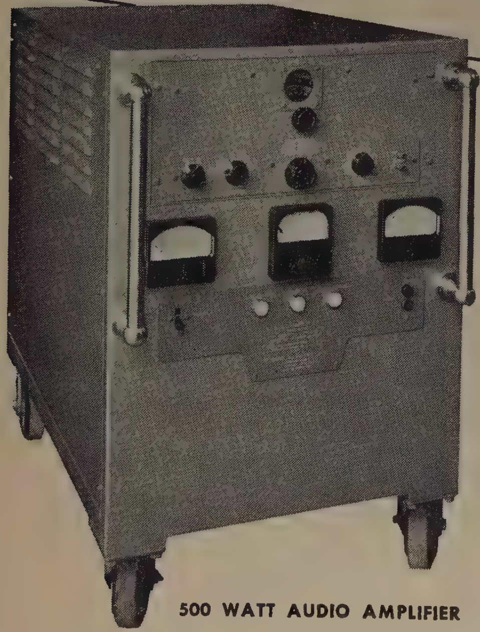
LEWIS and KAUFMAN, Ltd.
LOS GATOS 2 CALIFORNIA

LOS GATOS
LONG LIFE

For HIGH-POWER HIGH-PRECISION VIBRATION TESTING

High-precision vibration testing — up to now — has been limited to small components and assemblies. The new P & B 500 Watt Audio Amplifier has greatly extended the test range by making available fairly massive outputs of power to operate shaker tables.

The amplifier is normally driven by a built-in audio oscillator, or if desired, by an outside source such as a tape recording of unique vibration waveforms. It delivers 500 watts of output power over a frequency range of 15 to 500 cycles with minimum distortion and negligible hum. Continuous power metering is provided by an ammeter, voltmeter and wattmeter on the control panel.



500 WATT AUDIO AMPLIFIER

General Characteristics

FREQUENCY RANGE — 15 to 500 cycles per second.
POWER OUTPUT — 500 watts into a resistance load.
OUTPUT IMPEDANCE — 0.1, 0.4, 1.0, 4, 10, 40, 125 and 500 ohms at output transformer taps.
METERING — Output watts, current and voltage on control panel.
DISTORTION — Less than 5% at full power output above 30 cycles.
HUM — Less than 0.5% of maximum output voltage.
STABILITY — ±2% power output for line voltage changes of ±10%.
POWER INPUT — 115 volts, 30 amperes at 60 cycles.
SIZE — 24″ wide, 36″ high, 39½″ deep.
WEIGHT — 850 pounds.

For complete information write to:

PICKARD & BURNS
INCORPORATED
240 HIGHLAND AVENUE
NEEDHAM 94, MASS.

Pickard and Burns is a research, consulting, design and development organization specializing in radio and microwave communications, radar and electronics. We shall be pleased to discuss your related problems in complete confidence and without obligation.

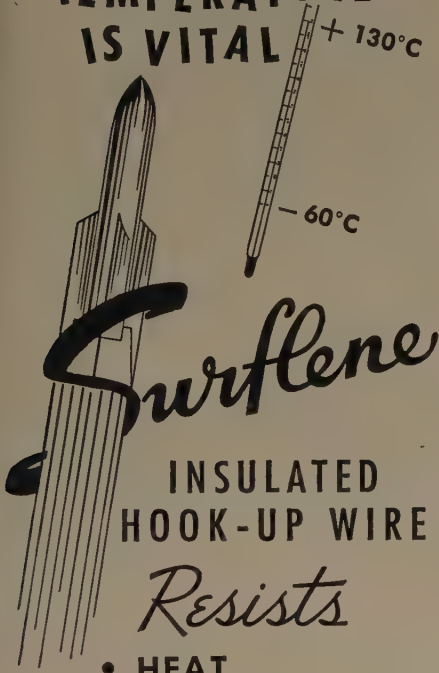
MEMBERSHIP

(Continued from page 116A)

Gaul, W. L., 1123 Susquehanna Ave., Sunbury, Pa.
Geissinger, E. L., 601 Boston Blvd., Sea Girt, N. J.
Gibbons, H. M., 128-A Kenville Rd., Buffalo 15, N. Y.
Gillette, E. H., 2 East End Ave., New York, N. Y.
Glauberman, M. H., Philip St., Medfield, Mass.
Goldstone, L. L., 91–20—90 St., Woodhaven 21, L. I., N. Y.
Gorden, H. C., 2242 Sepulveda Blvd., Los Angeles 64, Calif.
Graves, J. E., 1208 Kaneohe Bay Dr., Kaneohe, Hawaii
Greenfield, M., 1 Linden Lane, Levittown, Pa.
Greenwood, T. L., 1709 La Grande St., Huntsville, Ala.
Grieser, G. J., 4449 Witherspoon Ave., Merchantville 10, N. J.
Grieser, T. F., 5221 Greene St., Philadelphia 44, Pa.
Guiney, R. J., 66 Fuller St., Waltham 54, Mass.
Gurdak, E. D., 1158 Hildebrandt Ave., Schenectady, N. Y.
Gurien, S., 557 W. Market St., Long Beach, L. I., N. Y.
Haire, B. G., 508 Watson Ave., New Bern, N. C.
Hall, J., 40 Crestwood Ave., Nutley, N. J.
Halprin, J., 1030 E. Dorset St., Philadelphia, Pa.
Haltiwanger, J. C., 408 Baltimore Rd., Rockville, Md.
Hans, W. J., 703 Josina Ave., Palo Alto, Calif.
Hansen, A. N., 7607 Williams Way, Elkins Park, Pa.
Harris, E. A., 123 West 74 St., New York 23, N. Y.
Harrison, W. E., 7547 Mayland St., Philadelphia, Pa.
Hartz, W. W., 74 Spring Brook Rd., Springfield, N. J.
Hawkins, G. V., 153 La Grange St., Vestal, N. Y.
Hawkins, R., 1406 Pacific St., Brooklyn 16, N. Y.
Heathershaw, R. T., 4716 W. Congress Pkwy., Chicago 44, Ill.
Helbig, W. A., 221 New Jersey Ave., Collingswood 7, N. J.
Helwick, E. A., 102 E. Beach, Pass Christian, Miss.
Henrikson, F. R., 20 Maple Ter., Melrose 76, Mass.
Henry, W. P., 377 E. Upsal St., Philadelphia, Pa.
Hilbert, E. A., 2308 Barcelona Rd., Schenectady 9, N. Y.
Hildebrant, B. M., 97 Edgewood Rd., Westwood, Mass.
Hiltner, R. P., 100 Northwood Ave., Silver Spring, Md.
Hilton, F. L., 718 Algonquin, Bensenville, Ill.
Hittel, L. A., Jr., 285 McKinley Rd., Grosse Pointe Farms 36, Mich.
Hoffman, G. O., Box 74, Cheshire, Conn.
Hoffman, R. C., 500 Washington Rd., Pittsburgh 16, Pa.
Hokanson, H. P., Jr., 14 Vine St., Medford 55, Mass.
Holl, W. H., 383 Shattuck Rd., Saginaw, Mich.
Holt, D. E., 3536 Atwater St., Los Angeles 39, Calif.
Howell, J. S., Jr., 1118 Skyline Dr., Grand Prairie, Tex.
Hubley, G. W., 1516 Second Ave., York, Pa.
Huie, J. A., 1784 Penfield Rd., Penfield, N. Y.
Huyler, L. E., Jr., 947 Ackerman Ave., Syracuse 10, N. Y.
Iffland, H. L., 4314 Warsaw, Fort Wayne 5, Ind.
Iribe, P., Chapman Rd., Kingsville, Md.
Iwahashi, K. K., 3120 Broadway, New York 27, N. Y.
Jablonski, R. W., 1 Elwell St., Seneca Falls, N. Y.
Jacoby, A., Australian Military Mission, 12 & Constitution Ave., Washington 25, D. C.
Johnson, B. F., 1102 Dean St., Brooklyn 16, N. Y.
Johnson, L. E., 3402 Oakland Rd., N.E., Cedar Rapids, Iowa
Johnson, R. W., 400½ S. Eighth, Independence, Kans.

(Continued on page 120A)

WHERE
RESISTANCE TO
HIGH AND LOW
TEMPERATURES
IS VITAL



Surflene

INSULATED
HOOK-UP WIRE

Resists

- HEAT
- FUNGI
- ABRASION
- CHEMICALS

"Surflene", extruded monochlorotrifluoroethylene, has high insulation resistance, dielectric strength and outstanding resistance to heat, abrasion, most chemicals and concentrated acids, including fuming nitric acid. It is non-inflammable and inert to fungi. It is especially designed for hermetically sealed and water-proof equipment and for high temperatures encountered in power supply and continuous duty apparatus. Also available in multi-conductor cables.

"Surflene" is available in thirteen colors — red, orange, yellow, pink, light and dark green, blue, gray, tan, brown, black, white and clear.

Write our Engineering Service TODAY for technical assistance.

Surprenant MFG. CO.
199 Washington St. Boston 8, Mass. Plant—Clinton, Mass.
Engineered Wire and Cable for the Electronic and Aircraft Industries

SEEING IS BELIEVING

Supplying the right answers to pilots and navigators by means of accurate, reliable instruments has been our work for more than twenty-four years.

- AIRCRAFT INSTRUMENTS AND CONTROLS
- OPTICAL PARTS AND DEVICES
- MINIATURE AC MOTORS
- RADIO COMMUNICATIONS AND NAVIGATION EQUIPMENT

Current production is largely destined for our defense forces; but our research facilities, our skills and talents, are available to scientists seeking solutions to instrumentation and control problems.

kollsman INSTRUMENT CORP.

ELMHURST, NEW YORK • GLENDALE, CALIFORNIA • SUBSIDIARY OF *Standard* COIL PRODUCTS CO., INC.

SQUARE PULSE GENERATORS for the MILLIMICROSECOND to MICROSECOND RANGE

Model 100
Square Pulse Generator
PRICE: $395.00 F.O.B. New York

For Nuclear Pulse Work, Radar, TV, Wide Band Amplifiers, and in the design, calibration and servicing of fast electronic systems:

NOW—A new Square Pulse Generator with a rise time of one millimicrosecond (10^{-9} seconds) and a pulse width which can be varied from one millimicrosecond to several microseconds provides the ideal test instrument for fast electronic circuits. Both positive and negative pulses of a 100 volts maximum amplitude, into low impedance (such as 50 ohm cable) are generated; the pulse amplitude can be varied from 100 volts to .006 volts in 1 decibel steps by means of selector switches on the front panel. One, two, or more pulse outputs, each of which can be individually attenuated and delayed are available in various models.

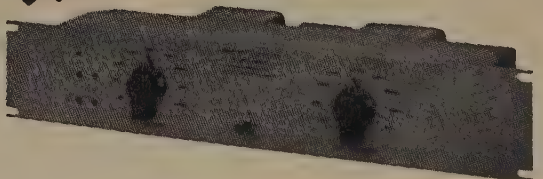
For further details, write for bulletin P-1C or contact our Engineering Division.

ELECTRICAL AND PHYSICAL INSTRUMENT CORPORATION

Sales and Business Office
25 West 43 Street
New York 36, N.Y.
Telephone: LOngacre 4-2265

Engineering Division
42-19 27th Street
Long Island City, N.Y.
Telephone STillwell 4-6389

HYCOR
TYPE 4200
Sound Effects Filter



This unit has been developed to meet present day requirements for compactness. The filter requires only 3½ inches of rack space.

Features . . .

- **LOW HUM PICKUP** through the use of toroid coils. The unit may be used in circuits having signal levels as low as —40 dbm without the necessity for taking special precautions against hum pickup.
- **LOW DISTORTION:** The filter may be used at levels up to plus 20 dbm with negligible intermodulation distortion.
- **RELIABILITY:** All capacitors and inductors are hermetically sealed for lifetime service. Aging effects are negligible.

General Specifications . . .

DIMENSIONS: Standard rack panel, slotted, 3½" high. Maximum depth 7½".
CONTROLS: Low frequency cutoff selector knob, high frequency cutoff selector knob, on-off key.
RANGES: Both low and high frequency cutoff controls cover 100, 250, 500, 1000, 2000, 3000, 4000 and 5000 cycles.
ATTENUATION: Approximately 16 db, per octave on both high and low frequency cutoff points.
IMPEDANCE: 500/600 ohms, in-out.
FINISH: Engraved panel finished in medium gray baked enamel. (Special colors available upon request.)

The filter has standard input and output jacks located on the front panel in addition to the terminal block at the rear.

11423 VANOWEN ST., NORTH HOLLYWOOD, CALIFORNIA
HYCOR Company, Inc.
SUnset 3-3860

Manufacturers of Precision Resistors, Toroid Inductors and Electric Wave Filters

REPRESENTATIVES:
Jack Beebe, 5707 W. Lake Street, Chicago, Illinois
George E. Harris & Co., Box 3005, Municipal Airport, Wichita, Kansas
Marvin E. Nulsen, 5376 E. Washington St., Indianapolis 19, Indiana
Burlingame Associates, 103 Lafayette Street, New York City

For further information contact your nearest Hycor representative or write for Bulletin S

MEMBERSHIP

(Continued from page 118A)

Johnston, W. F., 100 Morningside Dr., New York 27, N. Y.
Jones, C. L., General Electric Co., 777—14 St., N.W., Washington, D. C.
Juchno, E. A., 5725 Willowton Ave., Baltimore 14, Md.
Judd, A. E., 114 Ross Ave., Buffalo 7, N. Y.
Kaifer, R. C., 1806—105 Ave., Oakland 3, Calif.
Kalisky, A., 614 W. 152 St., New York 31, N. Y.
Kazebee, C. R., 5426 N. 23 St., Arlington, Va.
Kelly, D. H., 1317 Lucile Ave., Los Angeles 26, Calif.
Kemnitz, W. G., 1024 Ainslie St., Chicago 40, Ill.
Kerner, S. J., 2238 Morris Ave., New York 53, N. Y.
King, S. M., ITE Circuit Breaker Co., 19 & Hamilton Sts., Philadelphia 30, Pa.
Kitabayashi, T., 2035½ Sawtelle Blvd., Los Angeles 25, Calif.
Knoob, G. B., 4066 Madison St., Riverside, Calif.
Kopriver, E. O., Radio Station WWGP, Box 651, Sanford, N. C.
Kouyoumjian, R. G., 196 W. 10 St., Columbus, Ohio
Kret, D. B., 7 Sylvan Pl., Nutley, N. J.
Krug, E. G., 4039 Hazelwood, Detroit 4, Mich.
Kullback, M., 609 New Jersey Ave., Brooklyn 7, N. Y.
Kuroiwa, Y., 124 Tsutsumikata-machi, Ohta-ku, Tokyo, Japan
Lake, J. R., 28 General Heath Ave., White Plains, N. Y.
Lambert, F. D., Westwood Ave., R. D. 1, River Vale, N. J.
Lamoreaux, F. H., 209 Clifford St., Newark 5, N. J.
Landers, J. J., 146 East St., Pittsfield, Mass.
Lanman, T. W., 10 Ardlock Pl., Webster, Mass.
Ledakowich, J. C., 94 W. 13 St., Bayonne, N. J.
Lee, K. O., 20 Tanager Lane, Levittown, L. I., N. Y.
Levinson, L., 3777 Locust Ave., Seaford, L. I., N. Y.
Levit, M., Metropolitan Oveaseas Supply Corp., 1133 Broadway, New York 10, N. Y.
Lewis, F. C., 28C Parkway Apts., Kings Hgwy. & Park Dr., Haddonfield, N. J.
Lieberman, I. J., 6111 Pickford Pl., Los Angeles 35, Calif.
Liebman, H. S., 1750 Belmont Ave., New Hyde Park, L. I., N. Y.
Linney, F. J., Jr., 288 Pleasant St., Stoughton, Mass.
Longley, P. B., 9112 Crosby Rd., Silver Spring, Md.
Lopes, R. E., 2688 Riverside Ave., Somerset, Mass.
Love, S. D., 3518 Stanton Rd., S.E., Washington, D. C.
Lynch, W. J., Mecca Film Laboratories, 630 Ninth Ave., New York, N. Y.
Maczali, G. J., 1232-D Clifton Ave., Clifton, N. J.
Mandelkehr, M. M., 1277 S. Merrimac Rd., Camden, N. J.
Maguire, J. P., 91 Lawrence St., Farmingdale, L. I., N. Y.
Malmberg, R. A., 6 Upland Rd., Quincy 69, Mass.
Marcy, S. P., 316 Herbert St., Perth Amboy, N. J.
Marsh, R. H., 1113 Slater St., Toledo 12, Ohio
Marshall, B. O., 166 S. Arlington Ave., East Orange, N. J.
Martinson, O. M., 5 Bond St., Great Neck, L. I., N. Y.
Mascari, P. F., 253 Seventh Ave., Long Branch, N. J.
Masonson, M., G6 Green Brier Ct., Clifton, N. J.
Mathis, J. E., 316 Jones Pl., Shelby, N. C.
Matilla, A. H., 12242—12 St., N.W., Seattle 66, Wash.
Matt, S., 416 W. Fifth Ave., Columbus 1, Ohio
Mazur, S., 1496 Union St., Brooklyn 13, N. Y.
McBurney, R. E., 19 Inglewood Pl., Ottawa 3, Ont., Canada
McCarty, J. R., 34 Woodland Rd., Bloomfield, N. J.
McCollough, E. C., Orinoco Mining Co., Apartado 2736, Caracas, D. F., Venezuela
McCoy, B. F., 146 N. Delaware Pl., Tulsa, Okla.

(Continued on page 122A)

Top Service

IS ASSURED WHEN YOU ORDER YOUR

RAYTHEON

TUBES

and JUNCTION TYPE

TRANSISTORS

FROM

DALIS

Metropolitan New York's Foremost Electronic Distributor

Immediate Delivery From Stock

Seal of HLD Service

PHONE: ALgonquin 5-3000
WRITE or WIRE: Dept. IND
TELETYPE: N. Y. 1-2482

H. L. DALIS INC.

WHOLESALE DISTRIBUTORS
ELECTRONIC EQUIPMENT
175 VARICK ST., NEW YORK 14

SERVING THE TRADE FOR OVER A QUARTER CENTURY

If you use equipment which emits radio frequency energy directly upon a work load, you may find yourself in trouble with the FCC. And, if you're a manufacturer of offending equipment, you may also find yourself in trouble with your customers.

This seems to be the gist of the current FCC announcement. Beginning June 30th, 1953, the Commission has expressed its intention to seek out all offenders. Exceptions, so it is said, will be few, and these only for "reasonable" extension. In the Commission's own words:

"Part 18—The operation in the industrial, scientific, and medical service, of medical diathermy equipment, industrial heating equipment and miscellaneous equipment of a type which emits radio frequency energy upon frequencies within the radio spectrum constitutes a serious source of interference to authorized radio communication services operating upon the channels of interstate and foreign communication unless precautions are taken which will prevent the creation of any substantial amount of such interference."

"FCC Public Notice 85968—Accordingly, all interested persons are advised that the commission has no present intention of adopting any further general extension of the terms for compliance with the applicable portions of Part 18 of the rules beyond June 30th, 1953."

The FCC "Crack-down" ...and you!

This would seem to leave only two alternatives: (1) shut down offending equipment for good, or (2) stop the interference. In this latter connection, the FCC states:

"A well designed shielded space or room may be expected to reduce substantially or eliminate such interference."

An inexpensive shielded enclosure designed for this specific purpose has just been developed by Ace Engineering & Machine Co. It enables violators to comply with the FCC requirements at minimum cost. Actually, it is the most inexpensive enclosure ever produced commercially. Its effectiveness in eliminating interference is proved by the thorough tests of an independent laboratory. And, behind it, stands the guarantee of a company that has long provided shielding far beyond FCC requirements for America's largest electric-electronic manufacturers . . . better and cheaper than they could make in their own plants.

Look over your equipment now—especially for induction heating, dielectric sealing, electric welding, and diathermy apparatus. If there's a unit that may invite a call from the FCC, write, wire or phone us without delay. We'll send you (1) An official copy of the complete Part 18 of Federal Communications Commission Rules and Regulations, and (2) A bulletin describing the Ace low-cost solution. But do it today for, if you're an offender, the FCC promises to visit you sooner or later.

SHIELDED ACE ROOMS

ACE ENGINEERING & MACHINE CO.
3644 North Lawrence Street
Philadelphia 40, Pennsylvania REgent 9-1019

S.S.White MOLDED RESISTORS

The "All-Weather" Resistors

TYPE 65X
(Actual Size)

The resistors that give you...

- *Inherent low noise level*
- *Good stability in all climates*

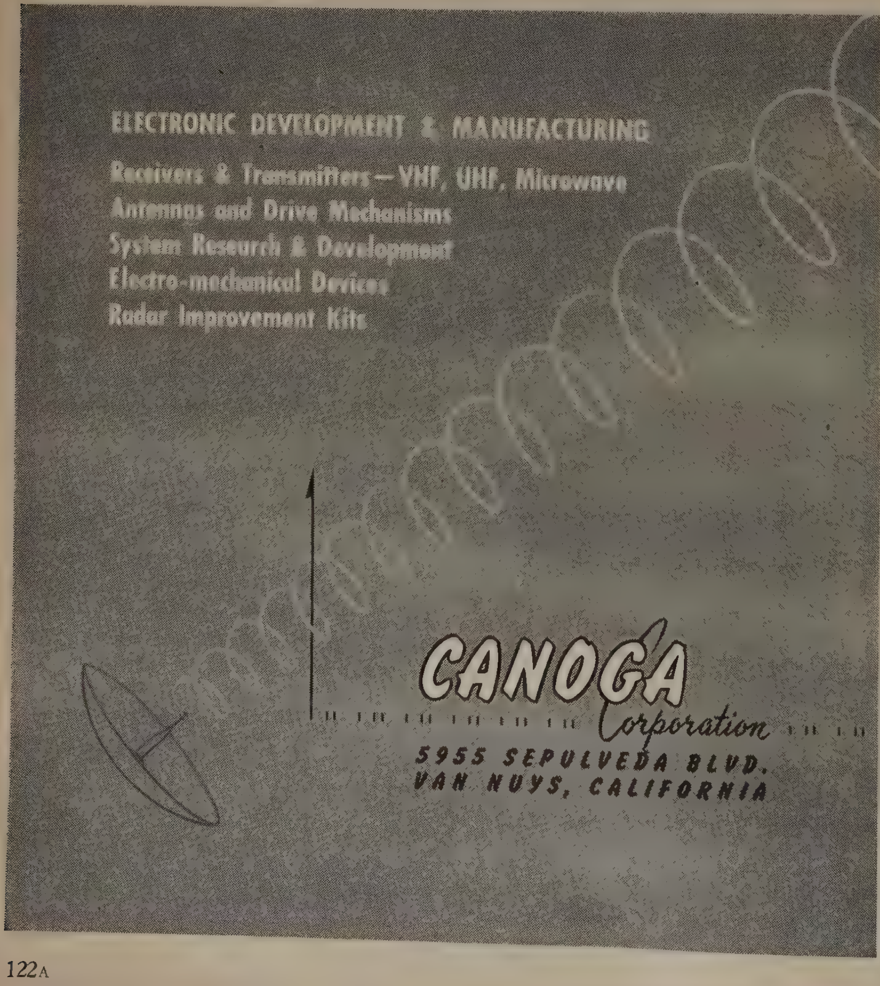
STANDARD RANGE
1,000 OHMS TO 9 MEGOHMS
These resistors are used extensively in commercial equipment, including radio, telephone, telegraph, sound pictures, television, etc. They are also used in a variety of U. S. Navy equipment.

HIGH VALUE RANGE
10 TO 10,000,000 MEGOHMS
This unusual range of high value resistors has been developed to meet the needs of scientific and industrial control, measuring and laboratory devices—and of high voltage applications.

SEND FOR BULLETIN 4906
It gives details of Standard and High Value Resistors, including construction, characteristics, dimensions, etc. Also described are S.S.White 80X Resistors, designed for extremely high voltage equipment. Copy with Price List sent on request.

THE S.S.White INDUSTRIAL DIVISION
DENTAL MFG. CO.
Dept. GR 10 East 40th St.
NEW YORK 16, N. Y.

WESTERN DISTRICT OFFICE: Times Building, Long Beach, Calif.



ELECTRONIC DEVELOPMENT & MANUFACTURING
Receivers & Transmitters—VHF, UHF, Microwave
Antennas and Drive Mechanisms
System Research & Development
Electro-mechanical Devices
Radar Improvement Kits

CANOGA Corporation
5955 SEPULVEDA BLVD.
VAN NUYS, CALIFORNIA

MEMBERSHIP

(Continued from page 120A)

McGuire, T. S., RCA Communications, 66 Broad St., New York, N. Y.
McHugh, R. J., 5909 Saul St., Philadelphia 24, Pa.
McIndoe, C. W., Grahm Terr., Butler, Pa.
McNealus, A. L., 287 Fendale St., Franklin Square, L. I., N. Y.
McRae, D. W., 425 Dovercourt Rd., Sault Ste Marie, Ont., Canada
Meksraitis, J. J., 1607½ DeLeon St., Tampa 6, Fla.
Melland, B. T., 3526 Van Buren Ave., El Paso, Tex.
Merrigan, A. F., 2917 Haverford Rd., Ardmore, Pa.
Mikkelson, M. E., 1434 Santa Monica Blvd., Santa Monica, Calif.
Miller, A. G., 63 Bedford Rd., Pleasantville, N. Y.
Miller, J. R., 1940 Beach St., Winston-Salem, N. C.
Mills, G. G., 5334—32 St., N.W., Washington 15, D. C.
Mills, R. E., 2159 E. Cumberland St., Philadelphia 25, Pa.
Mitchell, A. T., 408 Linwood St., S.W., Cedar Rapids, Iowa
Monda, S. M., 1533 S. Avers Ave., Chicago 23, Ill.
Montalbano, V., 6746 N. Greenview Ave., Chicago 26, Ill.
Moore, C. G., Jr., NAESU, NRS, Washington 25, D. C.
Morgan, H. C., 5015 Canoga Ave., Woodland Hills, Calif.
Morley, A. R., 63 Broad St., Matawan, N. J.
Morrill, D. W., 113 N. Ninth St., Yakima, Wash.
Mosher, R. M., 1507 Monroe Ave., Rochester 18, N. Y.
Moshier, L. S., Jr., 200 N. Broad St., Selinsgrove, Pa.
Moyant, G. C., Box 35, GAFB, Rome, N. Y.
Muldoon, R. P., Rose Manor, E. State St., Doylestown, Pa.
Murtha, G. A., International Business Machines Corp., Poughkeepsie, N. Y.
Nash, H., Development Detachment, Signal Corps Electronics Laboratory, Ft. Monmouth, N. J.
Nedell, E., 280 Ft. Washington Ave., New York 32, N. Y.
Neideffer, C. R., 1155 Kagawa St., Pacific Palisades, Calif.
Newton, K. G. D., 54 Davies Cres., Toronto, Ont., Canada
Nikkel, R. F., 9 Third Ave., Ottawa, Ont., Canada
Nilssen, R. N., 20 Davis Rd., Waverley 79, Mass.
Nishi, E., c/o Hitachi Ltd., Marunouchi, Tokyo, Japan
Noland, J. W., 2522 San Rae Dr., Dayton 9, Ohio
Noyes, R. A., Croft Rd., Poughkeepsie, N. Y.
Nutt, J. H., 479 Beverwil Dr., Beverly Hills, Calif.
Ohlsson, A., Embassy of Sweden, 2247 "R" St., N.W., Washington, D. C.
Oster, E. W., Jr., 8300 Ridgely Oak Rd., Baltimore 4, Md.
Packard, D., 770 M&M Bldg., Houston 2, Tex.
Pain, D. H., 627 Alamon Rd., Ridgewood, N. J.
Paley, M. O., 2 Mitchell Ave., Poughkeepsie, N. Y.
Parker, R., 170 W. Selden St., Mattapan, Mass.
Paterra, F. A., 2702 Wisconsin Ave., N.W., Washington 7, D. C.
Paul, F. H., 100 Gold St., New York 38, N. Y.
Paxton, C. L., 1033 Homewood Ave., Baltimore 2, Md.
Pendleton, F. C., A.M. & F. Co., 1075 Commonwealth Ave., Boston, Mass.
Perman, E. M., 2nd Squadron, AACS, APO 942, Seattle, Wash.
Peshel, R. L., 2708—73 Pl., Landover, Md.
Pettigrew, A. F., 60 Van Houten St., Bergenfield, N. J.
Plofker, M. H., 2039 Cruger Ave., New York 60, N. Y.
Raley, J. K., 2723 Welch St., Little Rock, Ark.
Randazzo, J. J., 278 Nassau Rd., Roosevelt, L. I., N. Y.

(Continued on page 124A)

BE SAFE WITH

Q-max

A-27

LOW-LOSS LACQUER & CEMENT

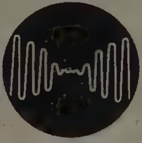
- Q-Max is widely accepted as the standard for R-F circuit components because it is chemically engineered for this sole purpose.
- Q-Max provides a clear, practically loss-free covering, penetrates deeply, seals out moisture, imparts rigidity and promotes electrical stability.
- Q-Max is easy to apply, dries quickly and adheres to practically all materials. It is useful over a wide temperature range and serves as a mild flux on tinned surfaces.
- Q-Max is an ideal impregnant for "high" Q coils. Coil "Q" remains nearly constant from wet application to dry finish. In 1, 5 and 55 gallon containers.

Communication Products Company, Inc.

MARLBORO, NEW JERSEY
(MONMOUTH COUNTY)
Telephone: FReehold 8-1880

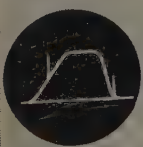
NEED INSTRUMENTS TO SOLVE **ELECTRONIC PROBLEMS?...**

RADA-SWEEP
Radar IF Amplifier Alignment



MEGA-MATCH
Measurement of Reflection Coefficient

MEGA-PULSER
Transient Testing Video Amplifiers



MARKA-SWEEP RF-P
TV Tuner Alignment

RADA-PULSER
Radar IF Transient Testing

CALIBRATED MEGA-SWEEP
Wide Range Sweeping Oscillator
Single Dial Tuned

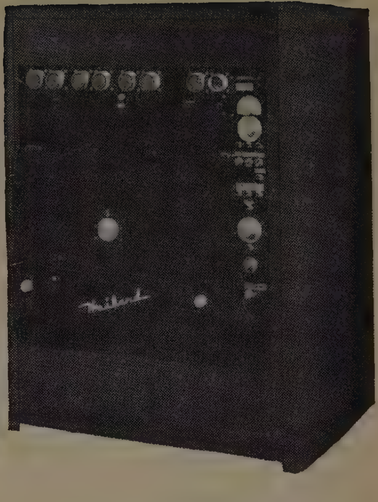
CONSULT THIS LATEST
64-PAGE
CATALOG

Write FREE

KAY ELECTRIC CO.

4 MAPLE AVE. PINE BROOK, N. J.

Its Easy... with Heiland



RACK MOUNTED 712-B (12") RECORDER...Operation, control, loading and adjustments from *Front Surface.*

"700" RECORDERS

...the *only* oscillograph recorder using 12" recording media that can be conveniently mounted in a 19" relay rack. All operating controls are on one surface. Loading and unloading can be accomplished easily and quickly from this same surface. Input connectors can be supplied as shown or installed on the top end of the recorder, leaving the operating panel free of cabling. "700" recorders can be supplied in 115 Volt, 60 cycle and 23.5—28.5 Volt D.C. Models.

Exclusive Heiland Features Designed for rack or table mounting • Operation, control, loading and maintenance from one surface • Direct monitoring of galvanometer light spots while recording • Damping resistor panel • Automatic light adjustment with record speed change.

Additional HEILAND FEATURES

- Simultaneous monitoring, scanning and recording
- Rapid, simple daylight loading
- Magazine capacity; paper 200', film 150'
- Adjustable record widths
- Adjustable automatic record length
- Automatic record numbering
- Footage counter
- Selectable recording speeds
- Precision time lines
- Event timer
- Static reference trace
- Trace identification
- Remote operation
- Multiple operation
- Lamp failure indicators
- Record travel indicator
- Compact...lightweight...rugged

Write for catalog giving complete information on the Heiland "700" recorders and other multi-channel recorders, accessories and galvanometers...

OPEN VIEW OF 708-B (8") recorder showing supply and take-up drums, operating controls.

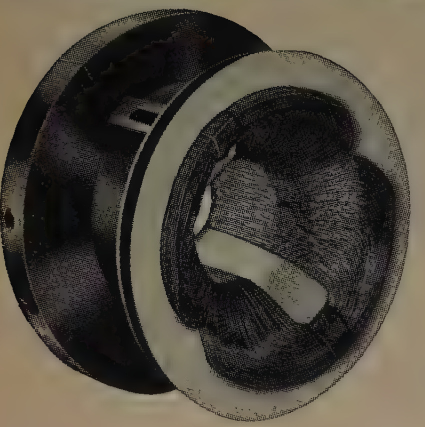
Other Heiland Recorders

500-B—Portable oscillograph recorder. Compact and lightweight providing maximum portability and versatility where it is desired to record up to 12 phenomena. 4" x 100' recording paper, 23.5—28.5 Volt D.C.

A-401—Completely portable. Optional 8 volt battery pack provides self contained power source. Can also be supplied in 23.5—28.5 D.C. Models. 6 channels, 2" x 100' recording paper.

Watch our ads for announcement of new products.

HEILAND RESEARCH CORPORATION 130 East Fifth Avenue, Denver, Colorado



DX Announces

a NEW 90° YOKE for 27" TUBES

It's Engineered for TOP PERFORMANCE ... in Production NOW!

This new DX 90° Deflection Yoke has everything a television receiver manufacturer wants . . . a sharp full-screen focus, a minimum of pincushioning, the ultimate in compactness and a price that's downright attractive. Because this yoke has been brilliantly designed for mass production on DX's specialized equipment, it warrants immediate consideration in your 27" receiver plans. Write us today.

DEFLECTION YOKES . . . TOROID COILS . . . CRYSTALS
I. F. TRANSFORMERS . . . R. F. COILS . . . DISCRIMINATORS
SPEAKERS . . . TV TUNERS . . . ION TRAPS . . . TRANSFORMERS

DX COMPONENTS "the heart of a good television receiver" TRADE MARK

DX RADIO PRODUCTS CO.
GENERAL OFFICES: 2300 W. ARMITAGE AVE., CHICAGO 47, ILL.

AGASTAT

Compact . . . Dust-Proof
TIME DELAY RELAYS
solenoid actuated—pneumatically timed

Introduces time delays into a-c or d-c circuits. Easily adjusted to provide delays ranging from 0.1 second to five or more minutes.

The AGASTAT is small, light, and operates in any position. Dust-proof timing chamber assures long operating life with a minimum of maintenance.

Write for Bulletin.
Dept. A1-67,

AGA

Division of Elastic Stop Nut Corporation of America
1027 Newark Avenue, Elizabeth 3, New Jersey

MEMBERSHIP

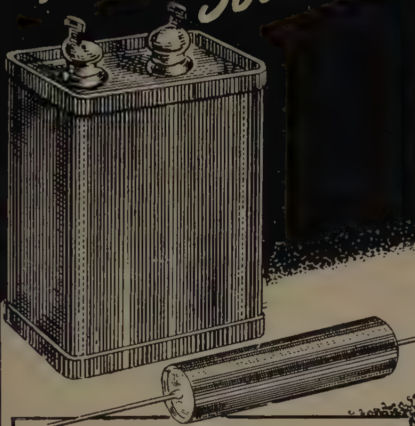
(Continued from page 122A)

Randolph, R. C., Box 872, Mather AFB, Calif.
Rauch, M., 1274—13 St., Brooklyn 19, N. Y.
Rensin, E., 60 W. 162 St., New York 52, N. Y.
Repac, R., 271 Crann St., Hillside, N. J.
Richman, D. W., 2121 Cedar Ave., New York, 68, N. Y.
Richter, H. L., 5754 Maspeth Ave., Maspeth, L. I., N. Y.
Ricker, H., 171 North Ave., Weston, Mass.
Robertson, A. L., 7035 W. 16 Pl., Denver 14, Colo.
Robichaud, L. P. A., 1267 Ave. Villars, Sillery, Que., Canada
Robinson, R. R., Plymouth Rd., Gwynedd Valley, Pa.
Rodriguez, E., Calzada 164, Ent. L & L, Vedado, Havana, Cuba
Rodriguez, L. H., 240-11—128 Ave., Rosedale 22, L. I., N. Y.
Rosen, A., 125 Brighton 11 St., Brooklyn 35, N. Y.
Rosenberg, H. A., 98 Querida St., Bridgeport 4, Conn.
Rosenthal, S., 3801 Connecticut Ave., N.W., Washington, D. C.
Ross, K. J., 47 Cleveland Pl., Massapequa, L. I., N. Y.
Rowe, W. D., Analytical Section 5-L-51, Westinghouse Electric Corp., E. Pittsburgh, Pa.
Rudnick, J. J., 5301 Woodbine Ave., Philadelphia, Pa.
Russell, C. R., M.I.T. Graduate House, Cambridge 39, Mass.
Russo, R., 8909 Sylmar Ave., Van Nuys, Calif.
Saint-Amour, P. M., 1665 E. 73 St., Cleveland 3, Ohio
Salter, R. A., 8049 Bowen Rd., El Paso, Tex.
Saltzman, A. R., 333 Forest Ave., Willow Grove, Pa.
Saranan, B. L., Rombout Ridge, R. D. 2, Poughkeepsie, N. Y.
Schack, R. H., 1738 University Ave., New York 53, N. Y.
Schleicher, M., 21 Woodland Pl., White Plains, N. Y.
Schlener, J. E., 24 Merrill Rd., Watertown, Mass.
Schmidt, L., 24 Summer St., Passaic, N. J.
Schneider, M., 3957 Gouverneur Ave., New York 65, N. Y.
Schneider, P. R., 592 Corsicana Dr., Oxnard, Calif.
Schott, L. O., Bell Telephone Laboratories, Inc., Murray Hill, N. J.
Seebald, H. A., 20 Ely Pl., E. Orange, N. J.
Selvaggio, N. J., 732 E. 31 St., Brooklyn 10, N. Y.
Senf, G. A., 5177 Emporia Ave., Culver City, Calif.
Sharp, N. S., 1339 Wisconsin Ave., Washington 7, D. C.
Shaver, K. C., 4 McLaren St., Red Bank, N. J.
Sherman, P., 264 E. 211 St., New York 67, N. Y.
Shipley, D. G., RCA Laboratories, 140 Moriches Rd., Riverhead, L. I., N. Y.
Shipman, H. F., 4216 Ramey Ave., Ft. Worth 5, Tex.
Shoemaker, P. B., 14 Vincent Ave., Belmont 78, Mass
Shulman, M. B., 7935 Woolston Ave., Philadelphia 19, Pa.
Sico, A., 37 Kingman Ave., Revere 51, Mass.
Siegel, R., 496 Park St., Upper Montclair, N. J.
Sigler, H. R., Jr., 4765 Milrose Ave., Los Angeles 29, Calif.
Siller, J., Rm. 1-N-15D, Bldg. 92, National Bureau of Standards, Washington 25, D. C.
Silver, L., 200 E. Pearl St., Torrintgon, Conn.
Silverman, D., 1011 Hopkinson Ave., Brooklyn 12, N. Y.
Silverman, R., 3126 Forbes St., Pittsburgh 13, Pa.
Single, C. H., 463 E. Garden Rd., Pittsburgh 27, Pa.
Sirbola, H., 50 Englewood Ave., Brookline 46, Mass.
Slack, C. B., 66 Harvard Ave., W. Medford, Mass.

(Continued on page 126A)

capacitors

Optimum Solution



unicon

Polystyrene Capacitors

Unicon Polystyrene Capacitors are characterized by extremely high insulation resistance and Q, and very low power factor and dielectric absorption.

Thus they are ideal elements for use in electronic analyzers and computers in tuned circuits and wave filters, as standards of capacitance, and in radiation detection and power supply circuits.

Unicon Polystyrene Capacitors are available in many different types of housings as well as uncased for potted assemblies. Standard sizes available for prompt delivery are listed below.

POLYSTYRENE LISTING

Cat. #	Cap.	WVDC	Style Housing	Dimensions
A1-1- 50	.05	100	1	1-1/2" Lx1/2" D
A1-1- 100	.10	100	1	1-1/2" Lx3/4" D
A3-1- 250	.25	100	3	1"x1-13/16"x1 H
A2-1- 500	.50	100	2	1-1/16"x1-13/16"x1-5/8" H
A2-1- 1000	1.00	100	2	1-1/16"x1-13/16"x2-3/4" H
A1-3- 1	.001	300	1	1-1/2" Lx1/2" D
A1-3- 2	.002	300	1	1-1/2" Lx1/2" D
A1-3- 5	.005	300	1	1-1/2" Lx1/2" D
A1-3- 10	.01	300	1	1-1/2" Lx1/2" D
A1-3- 20	02	300	1	1-1/2" L1/2" D
A1-3- 50	.05	300	1	1-1/2" Lx3/4" D
A1-3- 100	10	300	2	2-1/2" Lx3/4" D
A2-3- 250	.25	300	2	1-1/16"x1-13/16"x2-1/4" H
A2-3- 500	.50	300	2	1-1/16"x1-13/16"x3-1/4" H
A2-3- 1000	1.00	300	2	1-1/4"x2-1/2"x3-1/2" H
A2-3- 2000	2.00	300	2	1-1/4"x3-3/4"x3-3/4" H
A2-3- 5000	5.00	300	2	3-3/4"x4-9/16"x3-3/8" H
A2-3-10000	10.00	300	2	3-3/4"x4-9/16"x5-1/8" H

NOTES:

A. Style 1 is hermetically sealed glass tube with metal end caps.

B Style 2 is hermetically sealed rectangular metal can. See JAN C-25 drawings of CP 70 cans for outline drawings.

C. Style 3 is hermetically sealed metal "bathtub" cans. See JAN -C-25 drawings of CP 53 cans for outline drawings.

D. 3% capacity tolerance is standard for polystyrene capacitors. Specials to ½% for Polystyrene capacitors are available at extra cost.

Capacitors made to your specifications

Write for Catalog F

film capacitors, inc.

337 East 139th Street New York 54, N. Y.
Telephone CYpress 2-5180

JOHNSON

KNOBS & DIALS

Custom Styling and Modern Design

Choose JOHNSON knobs and dials for your finest electronic equipment. They offer modern design and custom styling without costly tooling. Especially suited for laboratory, test and measuring instruments, radio transmitters, studio equipment and controls, they are made of tough black phenolic with heavy brass inserts. Gripping surface is excellent. 12 flutes, instead of the usual 8, add comfortable "feel" and beauty. Sides taper slightly, front surface is depressed to protect the attractive finish.

Available in many styles, the three basic knob diameters are 1⅛", 1⅝", and 2⅜". Knobs can be assembled with matching black molded phenolic skirts of 1½", 2-1/16", or 3" diameters; or nickel silver, chromium plated dial plates, 1½", 2¾", or 4". Finish diffuses light reflection, markings stand out clearly.

Other types and modifications available on special order. For complete information on JOHNSON knobs and dials, write for your free copy of General Products Catalog 973.

JOHNSON KNOBS AND DIALS

All knobs and dials fit standard ¼" shafts.
***Also available for ⅜" shafts.**

Cat. No.	Illus.	Description	Knob Dia.	Height	Skirt or Dial Dia.
116-214-1	1	Instrument knob, black phenolic, ¼" shaft	½		¾
116-214-2	1	Instrument knob, black phenolic, 3/16" shaft	½		¾
116-221	2	Knob with black phenolic skirt	1⅛	13/16	1½
116-261	2	Knob with black phenolic skirt	1⅝	29/32	2 1/16
*116-281	2	Knob with black phenolic skirt	2⅜	1 3/32	3
116-265	3	Vernier dial, 0-100, 180°. 3 to 1 friction drive	1⅛	13/16	2¾
116-285	3	Vernier dial, 0-100, 180°. 5 to 1 friction drive	1⅝	15/16	4
116-288	3	Vernier dial, 0-100, 360°. 5 to 1 friction drive	2⅜	1 5/32	4
116-262	4	Knob and chrome dial, 0-100, 180°. Single line indicator	1⅝	15/16	2¾
*116-282	4	Knob and chrome dial, 0-100. 180°. Single line indicator	2⅜	1 5/32	4
116-290	4	Knob and chrome dial, 0-100, 360°. Single line indicator	2⅜	1 5/32	4
116-226	5	Spinner Knob	1⅛	11/16	
116-266	5	Spinner Knob	1⅝	25/32	
*116-286	5	Spinner Knob	2⅜	31/32	
116-222	6	Knob with beveled satin chrome dial 116-222-1 100-0 over 180° 116-222-2 0-10 over 270° 116-222-3 1-7 over 180° 116-222-4 ON-OFF over60° 116-222-5 Single line 116-222-6 0-100 over 180°			
116-220	7	Knob only, black phenolic	1⅛	11/16	
116-260	7	Knob only, black phenolic	1⅝	25/32	
*116-280	7	Knob only, black phenolic	2⅜	31/32	

Other types and modifications available on special order. For complete information on JOHNSON knobs and dials, write for your free copy of General Products Catalog 973.

E. F. JOHNSON COMPANY

CAPACITORS, INDUCTORS, SOCKETS, INSULATORS, PLUGS AND JACKS, KNOBS AND DIALS, AND PILOT LIGHTS

204 SECOND AVENUE SOUTHWEST • WASECA, MINNESOTA

RREP TELEMETRY

REMOTE INSTRUMENTATION
by Radio or Land Line

Raymond Rosen Engineering Products, Inc., one of the foremost designers and producers of telemetering equipment, can solve your instrumentation problem promptly and accurately . . . Our Engineering Staff can show you the way in these and other typical applications: *Stress analysis on prototype aircraft • Guided missile research • Upper air investigation • Pilotless aircraft control • Long-range weather forecasting • Atomic research • Chemical process analysis • Pipe-line flow control • Flood forecasting • Physio-medical research • Flow-contour analysis on test vehicles*

RREP offers engineering services to aid in your installation, service and testing problems, including consultation on layout and application . . . emphasis on your particular needs and recommendations for additional uses.

Your inquiries will receive prompt attention.

Investigate the RREP 32 Channel Transmitting Set, for telemetering via radio link.

RREP

RAYMOND ROSEN ENGINEERING PRODUCTS, Inc.
32nd & Walnut Streets • Philadelphia 4, Pa.

Specification Coils

—for every requirement—radio, FM, TV and Government Applications!

Including Universal, Bank Wound, Universal Progressive and Solenoid. All are precision-built to highest engineering standards and conform exactly to specifications. For uniform high quality, prompt delivery and economical unit costs, specify coils by Fugle-Miller. Radio, TV and JAN specifications are a specialty. Phone, wire or write for quotations.

ADDRESS INQUIRIES TO DEPT. P-6

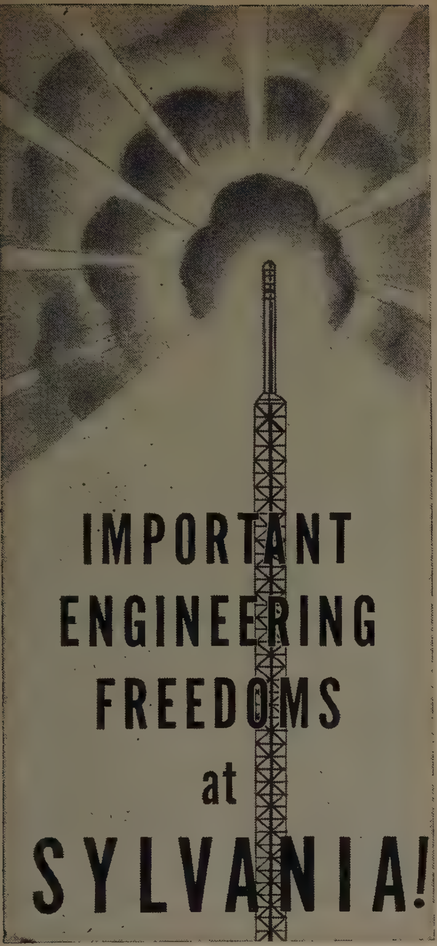
FUGLE-MILLER LABORATORIES
MAIN STREET, METUCHEN, NEW JERSEY
Telephone: Metuchen 6-2245

MEMBERSHIP

(Continued from page 124A)

Smith, A. H., Jr., Bldg. 20, Rm. 20C-114, Massachusetts Institute of Technology, Cambridge, Mass.
Smith, E. R., National Bureau of Standards, Sound Section, Division 6-1, Washington 25, D. C.
Smith, H. M., 58 Wickey Ave., Westbury, L. I., N. Y.
Sporn, S. R., 2855 Calflin Ave., New York, N. Y.
Somermeyer, H. F., Balaton, Minn.
Stahl, C., 482 E. Second St., Brooklyn, N. Y.
Staub, R. J., 1720 N. Sherman St., York, Pa.
Steale, C. T., Bladen, Ohio
Stella, R., 121–14 Farmers Blvd., St. Albans, L. I., N. Y.
Stephens, M. C., 271 Clayton Rd., Scarsdale, N. Y.
Stone, H. B., 1008 Grand Ave., Asbury Park, N. J.
Styner, T. L., YMCA Hotel, Rm. 67, 310 N. Illinois St., Indianapolis 4, Ind.
Sullivan, E., 2043 Haviland Ave., New York 72, N. Y.
Summers, J. W., 537 Mariposa Ave., Mountain View, Calif.
Summerville, R. W., 1213 E. 31 St., Brooklyn 10, N. Y.
Taber, R. F., 111 Goundry St., North Tonawanda, N. Y.
Tahirali, G. W., RCAF Station, Clinton, Ont., Canada
Thompson, R., 225 Wyleswood Dr., Berea, Ohio
Thrall, L. L., 11313 Prairie Ave., Inglewood 2, Calif.
Tinch, C. S., Jr., 1732 Bever Ave., S.E., Cedar Rapids, Iowa
Trinite, G. M., Jr., 5412 Montbel Ave., Baltimore 7, Md.
Trocky, E. V., 116 E. Chestnut Hill Ave., Philadelphia, Pa.
Tucker, B. W., 5221 Greene St., Philadelphia, Pa.
Tucker, N., 22; Grove, Waltham, 54, Mass.
Tullman, N. L., 869 Noble Ave., New York 72, N. Y.
Uhlir, A., Jr., Bell Telephone Laboratories, Inc., Murray Hill, N. J.
Vafiades, B. C., 186–27 Midland Pkwy., Jamaica, L. I., N. Y.
Vallelunga, J., 209 W. 21 St., New York 11, N. Y.
Vallieres, M. G., 3829 Dandurand St., Montreal, Que., Canada
Vilander, N. E., 7625 Hadley St., Overland Park, Kans.
Voegeli, F. E., Box 811, Georgia Tech, Atlanta, Ga.
Wakefield, P. R., R.F.D., Meyersville Rd., Chatham, N. J.
Ware, P. M., Jr., 25 Lovell Ct., Nutley 10, N. J.
Watkins, E. L., 778 Val Vista St., Pomona, Calif.
Watson, R. E., 1045 E. 38 Pl., Tulsa, Okla.
Wechsler, R., 612 Sherman Ave., Plainfield, N. J.
Weisberg, A. M., Box 965, Providence, R. I.
Wernick, J. I., 1937 Walton Ave., New York 53, N. Y.
Whatley, W. W., 8298 Jackies Dr., Cincinnati 24, Ohio
Whelan, R. E., 4025 Riverside Dr., Dayton 5, Ohio
Whitehurst, J. D., R. D. 2, Manchester, Tenn.
Whitlock, M. B., Jr., 1812 Allison St., N.W., Washington, D. C.
Whitney, R. J., 3131 N. Tenth St., Arlington 1, Va.
Wiggins, T. B., 322 East St., Rochester, Mich.
Wilkins, R. P., 3205 Bayonne Ave., Baltimore 14, Md.
Williams, A. R., 14 Robinwood Ave., Toronto, Ont., Canada
Williams, B. W., 24 Hasbrouck Dr., Poughkeepsie, N. Y.
Williams, L. T., 2659—24 Ave., San Francisco 16, Calif.
Williams, W. C., R. D. 1, Girard, Ohio
Wilson, B. F., 2616 E. 14 Pl., Tulsa, Okla.
Wilson, E. M., 415 Melrose St., Bristol, Tenn.
Winslow, R. B., Georgetown University, Washington, D. C.

(Continued on page 142A)



All too often, farsighted engineering ideas and aims are held in check by everyday job requirements. Engineers made of the right "stuff" hold a secret yearning to break the shackles of today — to think in terms of the possibilities of **tomorrow.**

Sylvania thinks that way, too — has thought so for years. As a result, Sylvania encourages its engineers to pioneer, develop, follow through on their ideas, write and speak on their chosen subject to gain professional recognition.

If you are looking for a stimulating **challenge that will last a lifetime** — investigate the splendid career opportunities with fast-growing Sylvania.

Send your resume to:

JOHN C. WELD
Supervisor of Employment
254 Rano Street, Buffalo 7, New York

DONALD BRADLEY
Personnel Supervisor
70 Forsyth Street
Boston, Mass.

SYLVANIA
ELECTRIC PRODUCTS INC.
RADIO AND TELEVISION DIVISION
254 RANO STREET
BUFFALO 7, NEW YORK

ENGINEERS

FOR ATOMIC WEAPONS INSTALLATION

Mechanical Engineers, Electronics and Electrical Engineers, Physicists, Aerodynamicists, and Mathematicians. A variety of positions in research and development open for men with Bachelors or advanced degrees with or without applicable experience.

These are permanent positions with Sandia Corporation, a subsidiary of the Western Electric Company, which operates the Laboratory under contract with the Atomic Energy Commission. The Laboratory offers excellent working conditions and liberal employee benefits, including paid vacations, sickness benefits, group life insurance and a contributory retirement plan.

LOCATE IN THE
Healthful Southwest

Albuquerque, center of a metropolitan area of 150,000, is located in the Rio Grande Valley, one mile above sea level. Albuquerque lies at the foot of the Sandia Mountains which rise to 11,000 feet. Cosmopolitan shopping centers, scenic beauty, historic interest, year 'round sports, and sunny, mild, dry climate make Albuquerque an ideal home. New residents experience little difficulty in obtaining adequate housing in the Albuquerque area.

APPLICATIONS NOW BEING ACCEPTED FOR TECHNICAL WRITERS

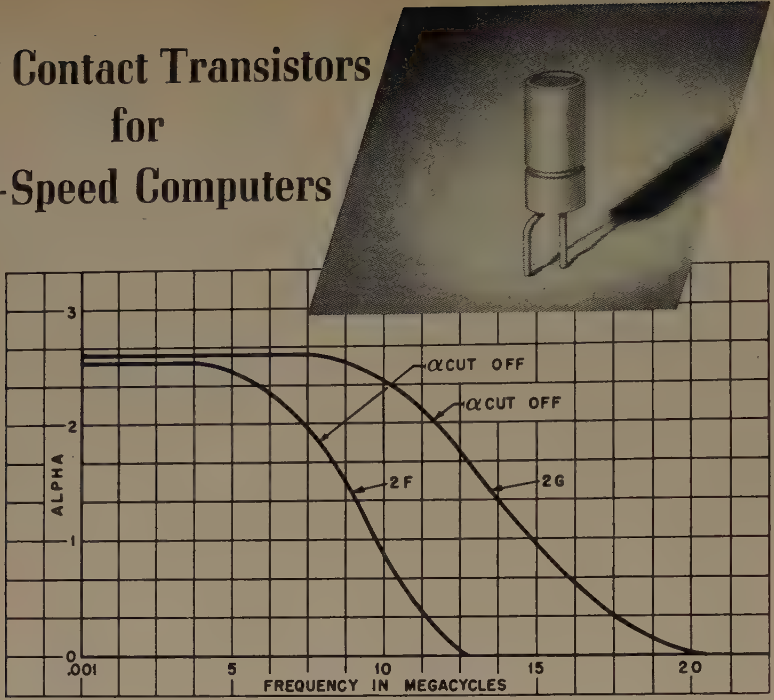
These are not Civil Service Appointments

Make Application to the
PROFESSIONAL EMPLOYMENT DIVISION

SANDIA
Corporation

SANDIA BASE
ALBUQUERQUE, N. M.

Point Contact Transistors for High-Speed Computers



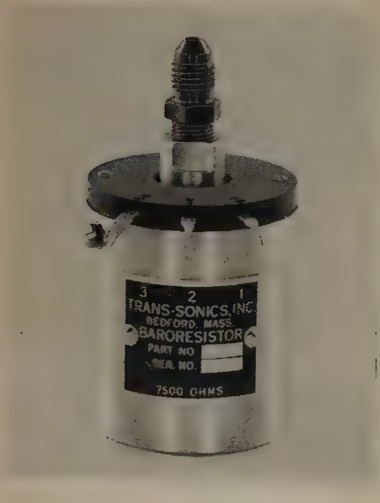
SPECIFICATIONS

2F
Frequency Response—5mc. α cut off
0.15 μsec. rise time

2G
Frequency Response—10mc. α cut off
0.1 μsec. rise time

Write Dept. P6 for detailed specifications

TRANSISTOR PRODUCTS, INC.
SNOW AND UNION STREETS, BOSTON 35, MASSACHUSETTS
AN OPERATING UNIT OF CLEVITE CORPORATION



TRANS-SONICS*

Type 71-5

BARORESISTOR

Important New Servo Component

The Type 71-5 Baroresistor is a pressure actuated potentiometer designed for operational use in aircraft. It features:

HERMETICALLY SEALED MECHANISM

The potentiometer winding and operating parts are hermetically sealed in a vacuum. Pressure is applied inside the bellows only. Therefore, the Type 71-5 Baroresistor is not affected by dust, fungi, or moisture.

RUGGEDIZED CONSTRUCTION

A special high force mechanism was developed for the Trans-Sonics Baroresistor to avoid the necessity for employing microforce potentiometer elements. Shock of 30g in any direction will not cause electrical discontinuity.

MACHINE CALIBRATION

Each instrument is calibrated by machine and its performance is automatically recorded as a graph of resistance versus pressure. Every turn of the winding is inspected. All electrical characteristics are automatically checked in an eleven stage inspection cycle.

Condensed Data

Range: 0-15 psi, absolute
Resistance: 7500 ohms
Maximum voltage: 75 volts
Resolution: 1/3%
Accuracy: 2% of full scale

Typical Applications

Servos—Vary servo loop gain as a function of altitude.
Computers—Voltage divider, P total/P static.
Fire Control—Air density measurements.
Telemetering—Pressure transducer.
Recording—Pressure transducer.

Write for Bulletin No. 71-5 for further details.

TRANS-SONICS, INC.
6 Forest Street, Bedford, Mass.

Price:
$225.00
Short delivery

*The word "Trans-Sonics" is a trade mark

Membership

(Continued from page 126A)

Wood, E. E., 424 Sierra Dr., S.E., Albuquerque, N. M.
Woods, C. R., 623 Edel Ave., Maywood, N. J.
Wright, N. E., 1027 Madison, Norman, Okla.
Zelen, H. J., 165 E. 205 St., New York 58, N. Y.
Zelman, B. B., 2325 Morris Ave., New York 68, N. Y.
Zimmerman, E. A., 522 Delaware Ave., Buffalo, N. Y.
Zinn, S., 216 Beach 149 St., Neponsit, L. I., N. Y.
Zucker, F. J., 1010 Massachusetts Ave., Cambridge, 38, Mass.
Zusman, D., 2118½ N. Kedzie Blvd., Chicago 47, Ill.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 117A)

Wescon Exhibit-Spaces Assigned

The growth curve of **WESCON** (Western Electronic Show & Convention), measured in exhibition-booth reservations, continues to climb with a new high figure of 316 booths assigned for the 1953 event to take place in San Francisco Civic Auditorium August 19–21, according to an announcement by Heckert Parker, Business Manager. Last year's booth total was 224. For this year's event, reservations exceeding the number of available booths had been received two months before the customary April assignment date, necessitating a revision of exhibit floor plans. The audio theater section was eliminated, and 17 booth spaces were added on the main floor. However, even with these revisions, some thirty-two concerns wanting space had to be turned away. Assigned exhibitors are all manufacturers of electronic equipment used in broadcasting, including fixed and mobile communication and navigation aids, measurement, instrumentation, industrial controls, sound, computation, telemetry, nucleonics and geophysics applications including replacement parts, service and installation accessories specialized production tools, technical periodicals, manuals and textbooks. Products for direct consumer use are not exhibited, nor is the general public admitted to the show.

Coaxial Speaker

A new coaxial speaker designed to improve and extend the frequency response, has been developed by the **Stephens Manufacturing Corp.**, 8538 Warner Dr., Culver City, Calif. This newest component of the Stephens Tru-Sonic line (Model 206AX), employs 7½ pounds of Alnico V magnet in a round pot structure. A new diaphram and high frequency throat structure, together with other improvements, have resulting in producing a high quality speaker.

An aluminum die-cast frame has been incorporated into the 206AX to provide greater rigidity and eliminate the possibility of warping.

(Continued on page 145A)

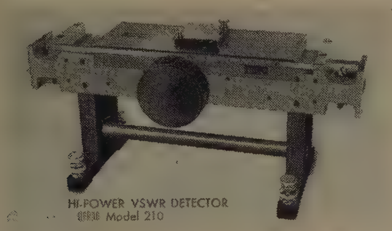
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 142A)

Impedance Meter

A new impedance meter, Narda Model 210 Hi-Power vswr Detector, product of **Nassau Research & Development Associates, Inc.,** 66 Main Street, Mineola, L. I., N. Y., measures the vswr of dummy loads, TR, ATR, system components and assemblies, and standard mis-matches for high power magnetrons. It works under actual operating conditions at any power level up to the maximum peak power rating of the waveguide, and vswr can be measured directly and simply at any duty cycle. This instrument is portable and suitable for either laboratory or field use. It is inserted in series with the transmission line and operated in the same way as conventional slotted sections, with the exception that there is no slot to radiate energy and no probe to break down. The operator moves the carriage and reads the vswr directly on the scale of any vswr amplifier, and determines phase from the scale and vernier mounted on the instrument. While measurements are made as quickly and easily as at low power, they are made more accurately since there is no error due to slope, lack of probe concentricity, an effects, or slot radiation, and there is no possibility of introducing a high residual vswr by too close coupling of the probe. At X-Band Model 210 may be used a power levels in excess of 250 to 300 kw.



HI-POWER VSWR DETECTOR
Model 210

Step Frequency Oscillator

Pulse Techniques, Inc., 1411 Palisade Ave., West Englewood, N. J., announces a new step oscillator providing 17 fixed frequencies. The instrument is portable for field maintenance, but its accuracy, stability and low distortion make it suitable in the laboratory, as well as for production line, testing of amplifiers, filters, recorders, and so on. It is also useful in

(Continued on page 146A)

CANNON PLUG ACCESSORIES for the "AN" Series

Here is the answer to a frequent question we receive from people everywhere. Yes, Cannon *does* make a complete line of accessories to be used in conjunction with the AN Series of connectors. Complete engineering data on each of these is given in the Cannon AN Bulletin, available on request.

CANNON ELECTRIC
Since 1915

Factories in Los Angeles, Toronto, New Haven Representatives in principal cities. Address inquiries to Cannon Electric Co., Dept. F-377, Los Angeles 31, California

TIE-TALKS FEATURE

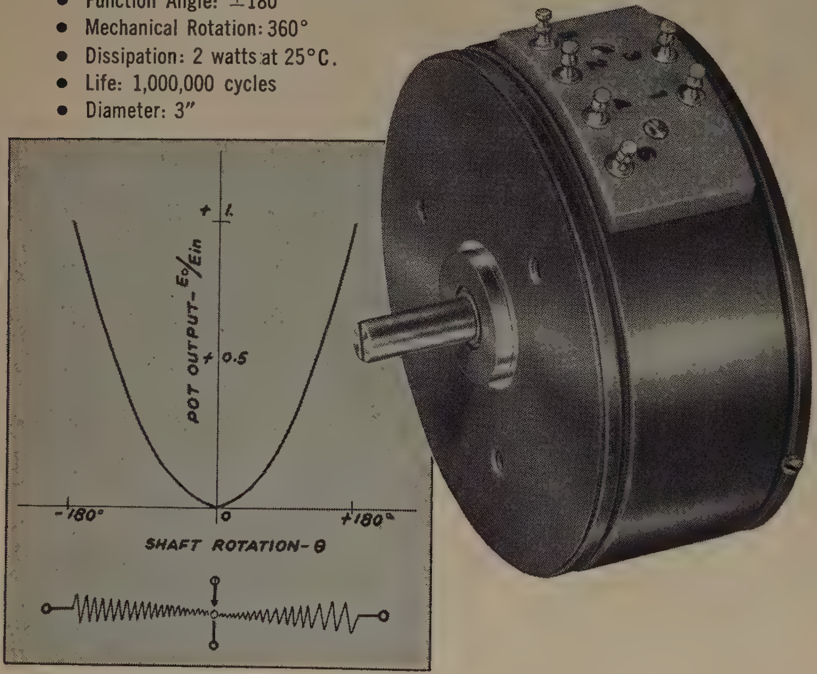
ANALOG COMPUTATION *with* TIC PRECISION POTENTIOMETERS

The type **RVP3-S121** solves the following mathematical equation:

$$\frac{E_o}{E_{in}} = \left(\frac{\theta}{180}\right)^2; \quad -180° \leqq \theta \leqq +180°$$

SPECIFICATIONS

- Total resistance: 2500±5%
- Conformity to function: ±0.25% Ein
- Function Angle: ±180°
- Mechanical Rotation: 360°
- Dissipation: 2 watts at 25°C.
- Life: 1,000,000 cycles
- Diameter: 3″



Your analog computations in control processes, computers, servomechanisms, and telemetering may likewise be solved by Technology Instrument Corporation precision potentiometers, with ease, economy and extreme accuracy. Precision non-linear potentiometers may be designed to meet your requirements from either implicit functions or empirical data. Submit your problem today for our analysis and recommendations.

A complete line of standard sizes is available, ranging from 7″ to ½″ in diameter. Greatly expanded facilities plus mass production techniques will meet your volume needs yet maintain precision tolerances in both linear and non-linear potentiometers. Write for catalog for complete information.

Engineering Representatives

Cleveland, Ohio — PRospect 1-6171
Chicago, Ill. — UPtown 8-1141
Rochester, N. Y. — Monroe 3143
Canaan, Conn. — Canaan 649
Dayton, Ohio — Michigan 8721
Baltimore, Md. — Plaza 7694

Arnprior, Ont., Can. — Arnprior 400
New York, N. Y. — MUrray Hill 8-5858
Cambridge, Mass. — ELiot 4-1751
Hollywood, Cal. — HOllywood 9-6305
Dallas, Texas — DIxon 9918
Binghamton, N.Y.—Binghamton 3-1511

TECHNOLOGY INSTRUMENT CORP.

535 Main Street, Acton, Massachusetts, Tel. ACton 3-7711

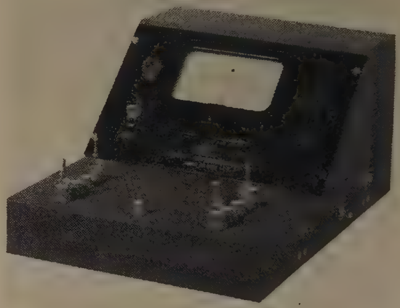
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 145A)

telemetering applications, and in the studio and maintenance shop. A gain-stabilizing circuit holds amplitude variation over the entire frequency range to less than ±0.2 db. Use of toroid coils is a factor in assuring an overall frequency stability of better than ±1 per cent, including replacement of tubes. The more than 60 db signal-to-hum ratio is maintained at all output levels, and known resistive output impedance is provided through use of a "T" pad attenuator. The frequencies supplied on the standard model cover the audio range. Other frequencies are available and any 17 will be provided on request. Distortion is less than 0.7 per cent throughout the range.

Comparison Bridge



Designed for production-line operation but capable of laboratory accuracy, the Model E-1 Comparison Bridge has been developed by **Southwestern Industrial Electronics Co.,** 2831 Post Oak Road, P.O. Box 13058, Houston 19, Texas.

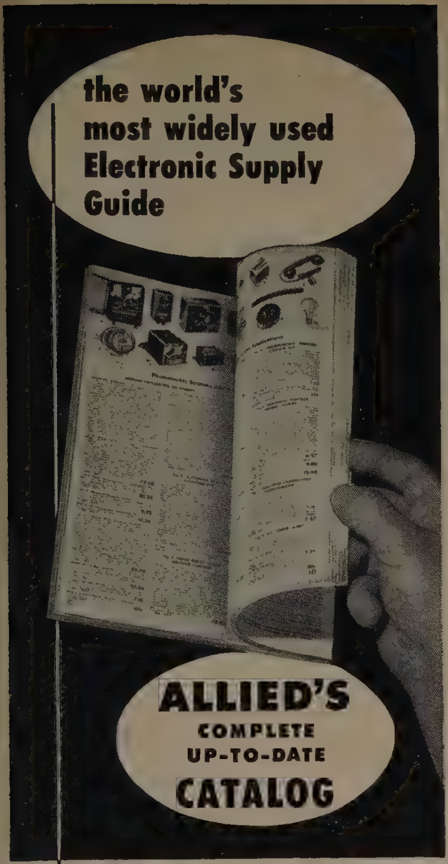
Five scales allow components to be matched or compared with standards within limits of 1, 2.5, 5, 10, and 25 per cent at full-scale deflection. The 1 per cent scale may be read accurately to indicate differences between components as small as one-tenth of one per cent. A bridge circuit applies three volts at 60 cps to the components under test, utilizing a transformer with a special bifilar winding to asssure uniformity of two legs. The difference voltage between the other two legs is fed to a three-stage amplifier through a five-step precision attenuator and is read directly in per cent on the meter. Components with impedances from one ohm to five megohms at 60 cps may be compared. It operates on 115 volt, 60 cps ac. Price is $150.00 FOB Houston, Texas.

Encapsulated Selenium Stacks

Federal Telephone & Radio Corp., Clifton, N. J., is now producing encapsulated selenium stacks.

The embedding of various components in Federal's new protective material minimizes failures due to dust, dirt, condensation, acid vapors and caustics. It provides

(Continued on page 148A)


the world's most widely used Electronic Supply Guide
ALLIED'S COMPLETE UP-TO-DATE CATALOG

The World's Largest Stocks of Electronic Supplies for Industry

Simplify and speed the purchasing of *all* your electronic supplies and equipment. Send your orders to us at ALLIED—the reliable one-supply-source for *all* your electronic needs. Depend on us for the world's largest stocks of special-purpose electron tubes, test instruments, audio equipment, electronic parts (transformers, capacitors, controls, etc.) and accessories—everything for industrial and communications application, for research, development, maintenance and production. We make immediate shipment from complete quality lines that are *always in stock.* Send today for your FREE copy of the ALLIED Catalog—the *complete, up-to-date* guide to the world's largest stocks of Electronic Supplies for Industrial use.

ALLIED RADIO
833 W. Jackson Blvd., Chicago 7, Illinois

One complete dependable source for everything in electronics

IMMEDIATE CAPACITY AVAILABLE

Whether your problem is the design of an electronic part or components of a major construction or equipment project, Teiner has the facilities, man power and technical skills to provide close tolerance work at low unit cost, with capacity to meet your immediate needs.

For all-gage — all metal — any quantity, manual or automatic spinning, roll forming or hydroforming, look to Teiner for early delivery. Send blue prints or drawings for quotes or write for newest brochure 53 I.

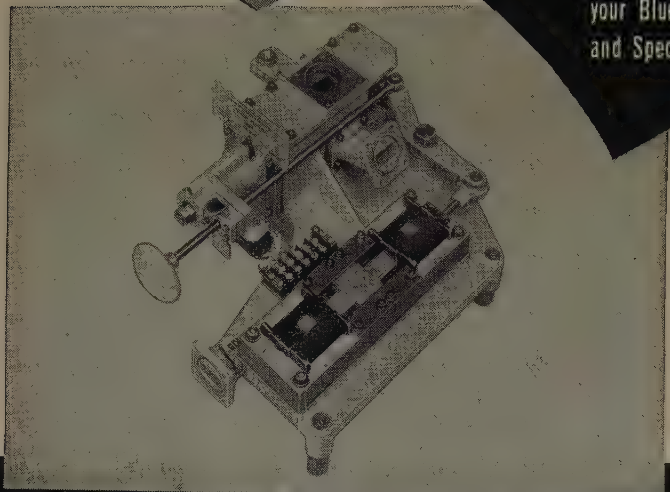
Save time and money — call Teiner now

ROLAND TEINER CO. INC. · METAL SPINNING ·

ROLAND TEINER
COMPANY, INCORPORATED
134 TREMONT ST., EVERETT 49, MASS. Tel. EV 7-7800

NRK

Microwave Assemblies, Radar Components, and Precision Instruments . . . manufactured to your Blueprints and Specifications.



N.R.K. MFG. & ENGINEERING CO.
4601 WEST ADDISON STREET • CHICAGO 41, ILL. • SPring 7-2970

HEXSEAL
FOR TOGGLE SWITCHES
PART No. 1030

A TRUE HERMETIC SEAL!

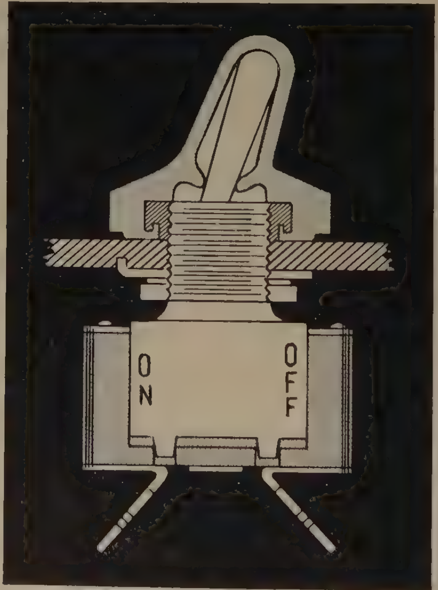
This boot is a high pressure seal for standard toggle switches. Being of single unit construction, it SAVES ASSEMBLY TIME.

The silicone rubber used in the boot is impervious to salt water, acids and ozone, and will operate in the temperature range of —80° F to 500° F.

APPLICATIONS: for equipments in
AIRCRAFT • ROCKETS • SHIPS
TANKS • FOOD MACHINERY • ETC.

A gasket rib which is an integral part of the HEXSEAL hermetically seals the boot to the panel. An internal constriction at the base of the toggle gives an additional safeguard. HEXSEALS meet the requirements of MIL Spec B-5423.

The simple construction permits the use of STANDARD TOOLS.



APM Hexseals can be designed and supplied to meet your special requirements. Our engineering department is available to assist with your problems.

APM

Manufactured by
AUTOMATIC and
PRECISION MANUFACTURING CO.
315 EAST 91 ST., NEW YORK 28, N. Y.

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

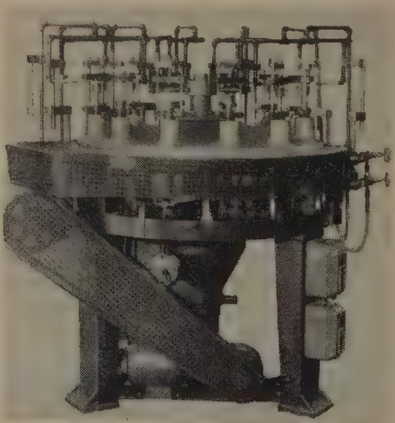
(Continued from page 146A)

maximum resistance to moisture, water, salt spray and solvents.

Because of the greater flexibility and compactness of design, components encased or sealed by the newly-developed process can be used where conditions formerly made their application impossible. Broader opportunities are afforded in the circuit field, where a multiplicity of components may be encapsulated as a unit. The necessity of sealing individual units is eliminated as well as the concern normally associated with exposed soldered junctions between individual units. Other applications include meeting special requirements, such as using encapsulated units as substitutes for oil-immersed units.

Lead Wire Welding Machine

Kahle Engineering Co., 1312 Seventh St., North Bergen, N. J., has an automatic lead wire welding machine (Model 2148) designed and built recently to make 12,000 3-pice leads per hour for miniature receiving tubes; it is also suitable as a machine to manufacture leads for transistors.



Another Kahle unit adaptable to transistor production is the fully automatic Filament Making and Tabbing Machine, Model 2036, that turns out from 1,000 to 3,000 fine wire assemblies per hour.

(Continued on page 150A)

Positions Wanted

(Continued from page 144A)

SENIOR ELECTRONIC ENGINEER

B.S. communications major. M.I.T. 1950. Experience in development of multiplex microwave communication equipment, and also of airborne radar equipment. Desires responsible position with challenging assignments. Locate in New York, New Jersey or New England area. Box 646 W.

ENGINEER

B.E.E. City College of New York 1951. Was discharged from U. S. Army March 1953. Now available for employment in communications and allied electronic fields. Please forward inquiries to Box 633 W.

ENGINEER

M.S. in E.E. Most significant experience in administration as Naval Officer. Released from active duty March 1953. Desires position involving general administrative engineering, or as Junior Engineer. Single, age 28. Prefer San Francisco area. Box 648 W.

MATHEMATICAL STATISTICIAN

M.A. Columbia University. 5 years in electronics, radar, guided missiles, AA fire control, tracking systems. Age 38, married, child. Prefer nonclassified work, analysis and evaluation of electronic systems. Box 649 W.

ENGINEER

Former Director of large trade school (electronics, electricity, radio and TV, radar, etc.). 12 years electrical engineering, teaching and management experience. Can initiate or join employee training programs for technicians or engineers. Box 650 W.

ELECTRONIC ENGINEER

B.S.E.E. University of California 1945. 1½ years gun-fire control systems, 1½ years lamp development (one patent); 3 years application of statistics to aircraft instrument manufacture. Member ASQC. TBII. Desires engineering or statistical quality control. Prefer west coast. Box 651 W.

ELECTRONIC ENGINEER

Electronic Engineer. Age 28. 3 years experience in design of electro-medical research equipment including AC and DC low-level amplifiers, stimulators, transducers and related equipment. Box 652 W.

ELECTRONIC ENGINEER—ADMINISTRATIVE

B.S.E.E.; SM IRE; communications engineer, radio and telephone, 11 years; Navy electronics officer, electronics training administrator, laboratory supervisor, instructor, 6 years. Age 39, married. Desires administrative or supervisory position. Minimum salary $8500. Box 653 W.

RESEARCH ENGINEER

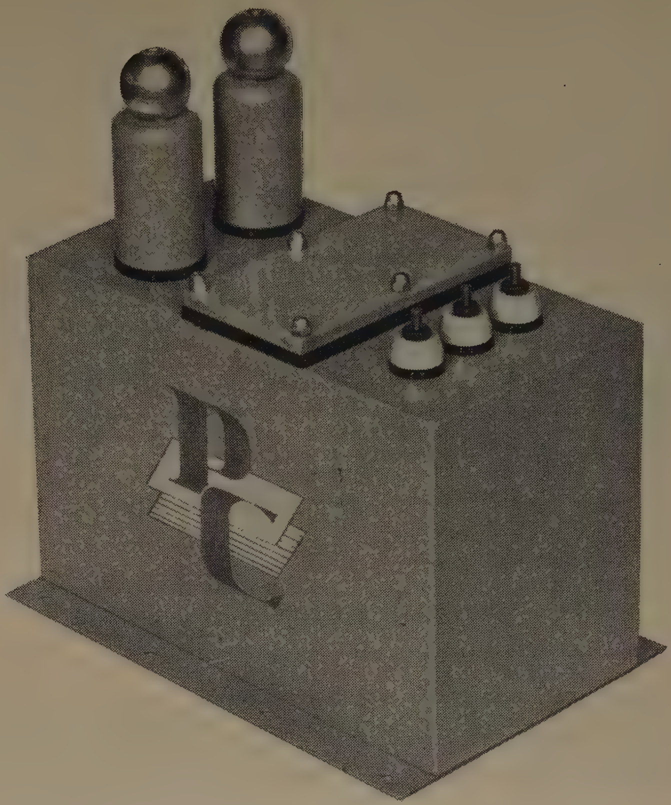
Ph.D. in E.E., minor in physics and mathematics. Desires position with opportunity for fundamental research. Experience in microwave electronics and digital computers. Prefer northeast or far west. Box 660 W.

ENGINEER

M.E.E., Polytechnic Institute of Brooklyn. 6 years experience R & D microwave components, presently group leader. Age 27, married, and draft deferred. Desires position with future in R & D and/or administration. Box 661 W.

(Continued on page 152A)

"High Voltage POWER PACKS"



APPLICATIONS:

For the operation of display tubes of all types, insulation and breakdown testers, precipitators, Geiger counters, Alpha counters, flocking, air samplers, dust collectors and general laboratory use.

FEATURES:

- operation with line frequency input of 60 cycles
- rectifier tubes can be replaced in the field
- can be used with Variac to control output voltage from zero to maximum design voltage
- hermetically sealed

ILLUSTRATED:

Model HV 200-102; delivering 20,000 volts at 1 ma with 118V, 60 cycle input, size: 4½" W x 7¾" L x 5½" H.

STANDARD Power Packs: for sea level operation and temperature range of minus 60° C to plus 70° C, voltage ranges from 2000 to 60,000 volts, current from 1 ma to 5 ma.

SPECIAL Power Packs: designed to suit your particular electrical and mechanical requirements—for all standard frequencies to 1500 cycles.

We invite your inquiries

Ask for our complete catalog on your company letterhead

Plastic Film Capacitors • High Voltage Power Packs • Pulse Forming Networks

PC

Plastic Capacitors, Inc.

2511 W. MOFFAT STREET, CHICAGO 47, ILLINOIS

New! COMPARISON TESTER for TRANSISTOR APPLICATIONS

TEST JUNCTION TRANSISTORS, POINT CONTACT TRANSISTORS, DIODES, AND OTHER SEMI-CONDUCTOR DEVICES ON A 'GO NO-GO' BASIS

Ideal for Factory Production and Laboratory Development

TRANSISTOR TESTER
MODEL TT-11

Price Complete* $189.50
F.O.B. Caldwell, N.J.

FEATURES
- ✓ Both Static and Dynamic Comparison Tests Performed
- ✓ Independent of Voltage and Temperature Variation
- ✓ Never obsoleted by new Transistor Types
- ✓ Simple to Operate ✓ Moderately Priced

Order your Transistor Tester today
or write for Bulletin B3

* Reference Transistors not supplied with this unit.

ELECTRONIC RESEARCH ASSOCIATES, INC.
BOX 29, CALDWELL, N. J.

WINCHARGER
TOWER and SERVICE
help WKAB-TV get on the Air in record time!

AB-TV PURSLEY BROADC
CHAN
Mobile 7, Alabama
PHONE 7-6345.

Mr. V. V. Holmes, Manager
Antenna Tower Department
Wincharger Corporation
Sioux City 2, Iowa

April 6, 1953

Dear Mr. Holmes:

Your cooperation in helping WKAB-TV to get on the air in record breaking time cannot be measured in dollars and cents. When we installed our 265 foot type 300 Wincharger some six years ago we had no idea of using this antenna for anything other than our A M operation. You can imagine our extreme delight to learn, during our recent TV installation, that we could also use our Wincharger as a mount for our 40 foot, 2500 pound, 5 bay, G.E. helical antenna. The trouble that you and your staff went to in restressing our Wincharger and furnishing us all Guying blue prints without cost was almost too much to expect, however, you and your staff came through in record time even to the machining of the top plate for the TV mount. We were also more than pleased with the reasonable cost and prompt service you gave us on the shipment of this plate.

I personally think that this type of service and interest that you and your organization manifested in us at a time when the element of time meant thousands of dollars should not go unrecognized. Mere words cannot express our sincere appreciation and gratitude for all you have done. It is with great satisfaction for a fine antenna installation that I write this letter of thanks to you.

Sincerely yours,
H. Eugene Miller
H. Eugene Miller
Chief Engineer
WKAB-TV

Quality that Endures!

That's the WINCHARGER combination, the reason why more TV, AM and FM stations specify WINCHARGER than any other tower. From coast to coast . . . and all over the world they have demonstrated their durability, ease and economy of maintenance and maximum efficiency. Whatever your tower needs may be, you'll find that WINCHARGER will serve you well, too.

TOP QUALITY
TOWERS
PLUS
WINCHARGER
ENGINEERING
SERVICE

WINCHARGER ENGINEERS are well qualified to advise you on your particular tower problems. A new booklet describing the latest Wincharger Towers is yours for the asking. Our consultation service is readily available without any obligation on your part. Write — wire — Phone 2-1844.

WINCHARGER CORP., 2115 E. 7th STREET, SIOUX CITY 2, IOWA

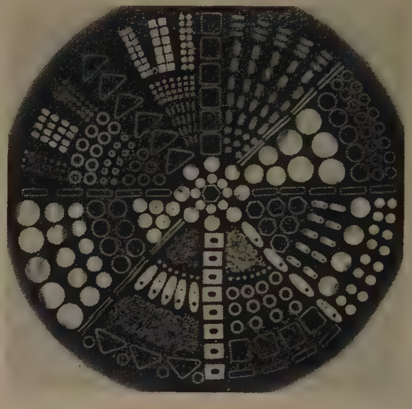
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 148A)

Solder Preforms

Kester Solder Co., 4201 Wrightwood Ave., Chicago 39, Ill., claims that their Solderforms are playing a prominent part in the manufacture and end-use of germanium diodes.



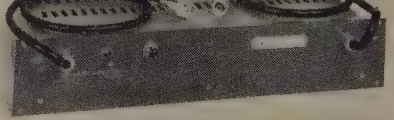
Solderforms, as their name implies, comprise any desired tin-lead alloy, with or without a flux, and made up in any required shape such as a ring, disc, pellet, washer, or spring. Other metal components can be included if required, as in the case of soldering germanium diodes, where silver is added to the basic alloy.

Any of the usually accepted methods of applying solder can be employed with Solderforms, it is said. They can be soldered with flame, carbon resistance, oven, hot-plate, induction heating, infra-red, or a conventional soldering iron.

Literally hundreds of different sizes and shapes of Solderforms have been produced, Kester says, including discs made from "paper-thin" stock 0.0015 inch, and rings with wire diameters from 0.020 to 0.250 inch. The firm cautions that preformed solder can be next to useless unless it is carefully packaged to insure that each single unit reaches its point-of-use in its exact original form. This, Kester states, is a critical point in the economical use of pre-formed solder.

TV Chain Amplifier

Spencer-Kennedy Laboratories, Inc., 186 Massachusetts Ave., Cambridge 39, Mass., has a new Model 212A-TV chain amplifier with a bandwidth of 40 to 225 mc. Up to twelve vhf television channels can be amplified simultaneously with high fidelity.



It is designed specifically for television distribution system requirements. Use of a parallel tube circuit gives the Model 212A-TV high operating reliability. Tube failure

(Continued on page 151A)

News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 150A)

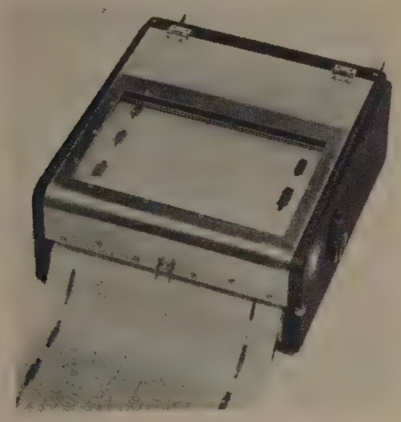
in an amplifier results in a loss of 1.6 db gain, not in a loss of the entire picture. Untuned circuit design eliminates loss of picture resolution because of inadequate bandwidth and frequency drift.

The Model 212A-TV has a gain of 21 db, with a flat frequency response from 40 to 225 mc. A new manual gain control is provided with a range of 5.5 db, as well as a plug for connection to the forthcoming SKL Broadband Automatic Level Control.

The amplifier and built-in power supply are adjusted in the factory and no further alignment need be made in the field. Coaxial cable-type connectors are supplied to match either 52 or 72 ohm lines.

Portable Six-Channel Oscillograph

A new portable six-channel oscillograph, designed for use where the need for a lightweight, compact and portable instrument is of prime importance, has been announced by **Brush Electronics Co.**, Equipment Division 31H, 3405 Perkins Ave., Cleveland 14, Ohio. Model BL-226 Oscillograph is equipped with six Model BL-902A Penmotors which permit the simultaneous recording of six channels of instantaneous electric phenomena, or mechanical phenomena that can be converted to electrical phenomena in the frequency range of dc to 100 cps.



A window in the top of the instrument permits viewing the chart as information is being recorded. Controls provide starting, stopping and selection of chart speeds of 5, 25, and 125 mm per second. A 25 foot length of cable and junction box provides all the necessary outlets for connecting six Brush amplifiers to the oscillograph.

As an accessory, a remote control box is provided, permitting the operator to start and stop the chart drive from remote locations. Outlets are provided in both the oscillograph and control box to permit use of a floor switch.

(Continued on page 152A)

LOW PASS FILTER by μ LAB

CUTOFF FREQUENCY 100-4000 Mc.

PASS BAND ATTENUATION 0.1 db. max.

PASS BAND VSWR 1.4 max.

PRICE $30.00-$40.00

Other models to specifications

MICROLAB
301 SOUTH RIDGEWOOD ROAD
SOUTH ORANGE, NEW JERSEY
COAXIAL COMPONENTS and TEST EQUIPMENT

DEADLINE FOR ADVERTISING
in
THE 1953 I R E DIRECTORY
is JUNE 15th

Have you placed your order yet?

DON'T DELAY, SEND YOUR ORDER IN TODAY

PHAZOR Pat. Pend. PHASE METER MODEL 200A

$349.50 F.O.B. New York, N. Y.

Measures phase shift in transformers, amplifiers, filters, and phase displacement networks.

- Measures from 0 to 360 degrees.
- Readings not affected by noise and harmonics.
- Phase shifts of the order of .01 degree can be measured employing special circuit techniques.
- Measures in-phase and quadrature components separately.

SPECIFICATIONS

Accuracy	Basic accuracy plus or minus 2 degrees. Plus or minus 1 degree due to meter error.
Noise and Harmonic Rejection	40 db. down
Sensitivity	6 millivolts full scale
Maximum Input Voltage	125 volts RMS
Peak Input Signal	400 volts
Frequency Range	20 to 20,000 cps.
Input Impedance	
High Gain	2.0 megohm shunted by 25 mmfd.
Low Gain	2.5 megohm shunted by 10 mmfd.
Reference Input Impedance	4000 ohms
Power Supply	105 to 125 volts, 60 cps., 25 watts
Dimensions	Length 15 in., Hgt. 9 in., Depth 8 in.
Weight	25 pounds

INDUSTRIAL TEST EQUIPMENT CO.
55 EAST 11th ST., N. Y. 3 - Tel: GR. 3-4684

ZOPHAR
---WAXES
---COMPOUNDS

Zophar Waxes, resins and compounds to impregnate, dip, seal, embed, or pot electronic and electrical equipment or components of all types; radio, television, etc. Cold flows from 100°F. to 285°F. Special waxes non-cracking at —76°F. Compounds meeting Government specifications plain or fungus resistant. Let us help you with your engineering problems.

107 YEARS
ZOPHAR MILLS, INC.
112-130 26th Street,
Brooklyn 32, N. Y.

IT'S
HARVEY
FOR PROMPT
"OFF-THE-SHELF" DELIVERY

Whether it's equipment, components or other electronic requirements, you will always find them in Harvey's extensive stocks, ready for immediate delivery to you anywhere.

Harvey's twenty-five years of service to the industry are your assurance of understanding 'know-how' and complete dependability.

WRITE
PHONE
or WIRE

HARVEY
RADIO COMPANY, INC.
103 West 43rd St., New York 36, N. Y.

Telephone
LUxemberg 2-1500

AN/APR-4 LABORATORY RECEIVERS

Complete with all five Tuning Units, covering the range 38 to 4,000 Mc.; wideband discone and other antennas, wavetraps, mobile accessories, 100 page technical manual, etc. Versatile, accurate, compact—the aristocrat of lab receivers in this range. Write for data sheet and quotations.

We have a large variety of other hard-to-get equipment, including microwave, aircraft, communications, radar; and laboratory electronics of all kinds. Quality standards maintained. Get our quotations!

We will buy any Electronic Material at top prices. SCHOOLS —unload your dusty surplus for cash or credit.

ENGINEERING ASSOCIATES

434 PATTERSON ROAD
DAYTON 9, OHIO

WANTED *To Manufacture and Sell— New Electronic Accessory Items*

For—FACSIMILE—RADIO—TELEPHONE—INDUSTRIAL TELEVISION

Note A—We have a special immediate need of Facsimile Equipment for Intra-Office and Plant use.

Note B—Selective Radio Signal Transmitter and Selective Radio Signal Receiver.

Receiver weight should be 5-10 ounces.

Will furnish capital if necessary to complete desirable developments.

What have you to offer?

RADIO ENGINEERING COMPANY
Inquirer Building
Philadelphia 30, Pennsylvania

Positions Wanted

(Continued from page 149A)

ENGINEER

Radio Engineer, communications—radar; physics, mathematics 1937. Age 35, married 1 child. 10 years experience. Desires research or design-development. Prefer non-classified because still alien; will accept other if given good opportunity. Box 632 W.

ENGINEER

A.B. Physics 1949, M.S.E.E. Stanford University, 1951. Age 27, married. 2 years instructor in electrical engineering. Electronics specialty. Engineering education primary interest. Desires Assistant Professorship at smaller western university. Varied background in research and practical electronics. Box 634 W.

ENGINEER

Degree 1948. 2 years design experience in aircraft electronic systems. 2 years design development of special equipment related to production of vacuum tubes. 1 year experience in field, lecturing and technical demonstration of television and test equipment. 3 years Army, telephone equipment and administration. Desires position in engineering administration. Box 635 W.

ENGINEER

B.S. physics June 1953. Sigma Pi Sigma, age 36. Entire college degree earned in part-time since marriage, 1 child. 3 years Army officer. Continuous employment in commercial/Army communications since 1935 (2 employers). 5 years marine operator, last 4 years TV broadcast with some supervisory work, remainder AM. Like TV but will consider allied fields. Box 636 W.

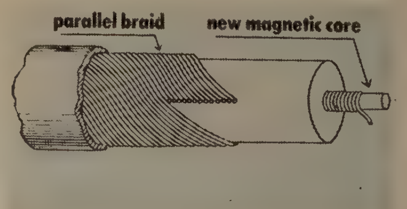
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 151A)

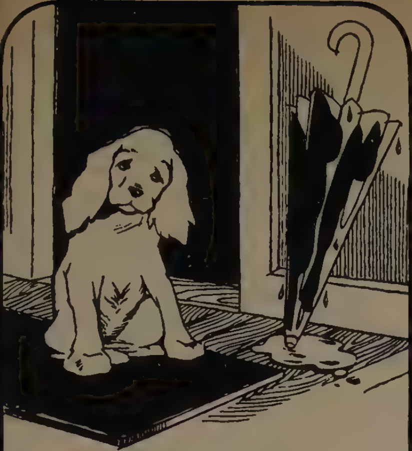
Delay Cable

Columbia Technical Corp., 5 East 57 St., New York 22, N. Y., has a new Type HH-2000 Delay Cable, designed to delay signals (both sine waves and pulses) for periods from a fraction of one microsecond to several microseconds. Its primary application is for such electronic circuits where minimum attenuation and signal distortion as well as fast rise time are required.



HH-2000 has a time delay of 0.11 microseconds per foot, and a nominal characteristic impedance of 2200 ohms. The attenuation for a delay of one microsecond is practically zero up to 3 mc, 0.5 db at 5 mc, and 2.5 db at 10 mc. As a result, the rise time is very fast. The band-

(Continued on page 154A)



MOISTURE

PROBLEMS

ARE ENDED . . .

WHEN YOU
SPECIFY

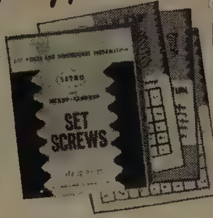
Standard Piezo
CRYSTALS

Continuing research, "up-to-the-minute" manufacturing methods and constant laboratory and field testing assure you of truly accurate and dependable performance under all types of unfavorable conditions, when you insist on Standard Piezo Crystals for your equipment. Send today for our new, free illustrated catalog.

Standard Piezo
COMPANY
CARLISLE, PENNA.

NEW SETKO Set Screw Catalog

NOW READY! FREE...



Your ANSWER to puzzling or regular SET SCREW PROBLEMS

Whether your application is a "puzzler" or just regular set screws, "right" in material, size, price and delivery—this Setko Catalog has the answer. A few highlights:

"NU-CUP" SET SCREWS—Read how they give greater holding power with same setting torque. Famous TV manufacturer has ordered over a million "Nu-Cups"!

ZIP-GRIP* SELF-LOCKING SET SCREWS—Catalog tells how ZIP-GRIP* is solving "vibration problem". No additional holding devices; exclusive "Contra-Thrust" action. Send for free ZIP-GRIP*Demonstrator and test samples.

HEXAGON SOCKET SET SCREWS—Read how Setko Socket Set Screws are milled from high-grade alloy steel bars heat-treated for maximum strength. Prices on all popular sizes, in stock.

BILLIONS OF SET SCREWS—New catalog contains results of our specialized experience making set screws for nearly 1400 manufacturers since 1935. Send for your FREE Copy.

125

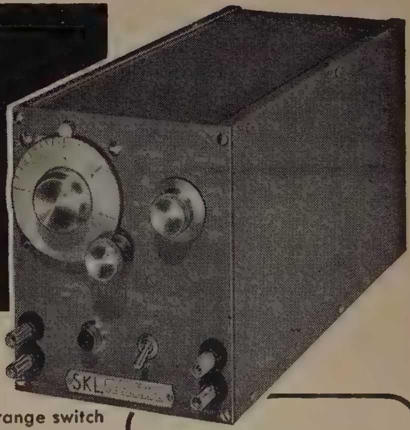
Set Screw & Mfg. Co.
422 Main St., Bartlett, Ill. (Chicago suburb)

FOR FREE CATALOG
Write your name and address in margin; tear out and mail to us today.

*Pat. Pend.

We Specialize in Solving Puzzling Set Screw Problems

MODEL 300
VARIABLE ELECTRONIC FILTER

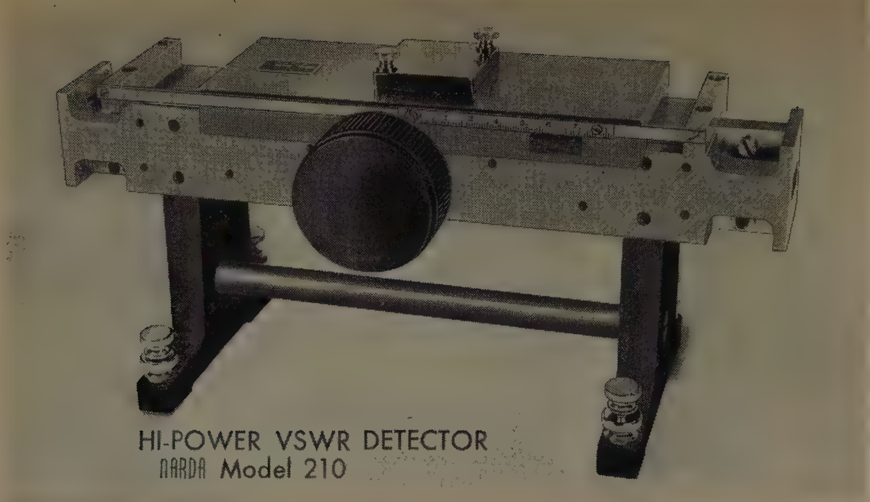


Two simple controls are all that are necessary to operate the Model 300 Variable Electronic Filter. With the variable frequency dial and range switch any cut-off frequency from 20 cps to 200 KC may be quickly and accurately selected and reselected. With the range switch either low-pass or high-pass filter action may be chosen. In either case the rate of attenuation is 18 db per octave and the insertion loss 0 db. For higher rates of attenuation or continuous band pass operation two or more sections can be cascaded. Its low noise level and flexibility of operation make the Model 300 indispensable in geophysical and acoustic research, industrial noise measurements, in the automotive and aircraft industries as well as the radio broadcasting, recording and motion picture studio.

Write for further information today.

SPECIFICATIONS
- CUT-OFF RANGE 20 cps to 200 KC
- ATTENUATION RATE 18 db per octave
- SECTIONS Single, can be high pass and low pass
- INSERTION LOSS 0 db
- PASS BAND LIMITS 2 cycles to 4 MC
- NOISE LEVEL 80 db below 1 volt

SKL SPENCER-KENNEDY LABORATORIES, INC.
181 MASSACHUSETTS AVE., CAMBRIDGE 39, MASS.


HI-POWER VSWR DETECTOR
NARDA Model 210

FOR THE FIRST TIME . . .
MEASURE VSWR AT 250,000 TO 300,000 WATTS!!

The FIRST X-Band instrument to measure VSWR directly at the maximum power rating of 1 by ½" waveguide.*

VSWR is read directly on conventional VSWR amplifier for measurements at ANY POWER LEVEL, ANY DUTY CYCLE, up to 300,000 Watts.

Uniquely adapted to DESIGN, DEVELOPMENT, and PRODUCTION tests on
HIGH POWER MAGNETRONS
DUMMY LOADS
TR — ATR's
SYSTEMS and COMPONENTS

* Other frequencies and sizes available.

The NARDA Line . . . 2,400 to 10,200 Mcs. Frequency Meter . . . Pulsed 25 to 35 Mcs. Signal Generator . . . Field and Laboratory Test Equipment.

MICROWAVE CONSULTING, TESTING, DESIGN . . . CUSTOM BUILT TEST EQUIPMENT.

NARDA NASSAU RESEARCH & DEVELOPMENT ASSOCIATES INCORPORATED
66 MAIN STREET MINEOLA, NEW YORK

Fine Aluminum Wire

• To meet the growing demand from producers of light-weight, high-frequency Galvanometer movements, we have expanded our facilities designed to process Wire of 2S Aluminum . . . This wire can be supplied in diameters ranging from approximately .001 inch through .005 inch . . . Anodized with an exceptionally thin and flexible dielectric coating.

Also available: wires of aluminum alloys enameled as small as .001 inch diameter, to meet rigid specifications of resistance, size and straightness.

Write for Latest List of Products

SIGMUND COHN CORP.
121 So. Columbus Avenue • Mount Vernon, N.Y.

News—New Products

(Continued from page 152A)

width (3 db down) for a delay of one microsecond is more than 0–10 mc, and correspondingly larger for smaller time delays. Compared to the commonly used RG-65/U cable, HH-2000 requires about two-thirds less cable length for a given delay, and its attenuation is a small fraction of that of RG-65/U. The capacitance per foot is 47 $\mu\mu$f and the dc resistance is 7.7 ohms/ft. Maximum operating voltage is 2,000 volts rms.

HH-2000 can be supplied in bulk (100 ft. lengths) or in pre-calibrated sections.

Frequency Meter

Berkeley Scientific Div., Beckman Instruments, Inc., 2200 Wright Ave., Richmond, Calif., has a new Model 5570 frequency meter, a direct reading instrument capable of measuring frequencies from 0 cps to 42 megacycles. Possible accuracies of 1 part in $10^7 \pm 1$ count can be attained. The indicated frequency is displayed in digital form on eight banks of panels.

Basically the Model 5570 consists of two sections: (1) a high speed Events-Per-Unit-Time Meter (EPUT), and (2) a heterodyne unit. Frequencies of 2 megacycles and below are applied directly to the EPUT section and are read on the last six decade number panels. Frequencies from 2 to 42 megacycles are applied to the heterodyne section, the megacycle selector knob turned to the proper harmonic and the results read directly on the eight decade number panels. Simplified adjustment of the heterodyne section selector knob is obtained by an output meter which indicates when the proper harmonic is reached. To obtain the accuracy of 1 part in $10^7 \pm 1$ count, provision has been made for externally adjusting the crystal control unit to WWV. This procedure is a simple one and can be easily made during frequency measurement.

By means of accessory heterodyne units, the complete range, up to 160 megacycles, can be read by this instrument. Price: $1990.00, F.O.B., Richmond, Calif.

(Continued on page 156A)

COMMUNICATIONS EQUIPMENT CO.

MAGNETRONS

TYPE	PRICE	TYPE	PRICE
2J21	$ 8.75	2J39	$24.50
2J22	7.50	2J49	59.50
2J27	19.95	2J61	34.50
2J31	24.50	2J62	34.50
2J32	28.50	3J31	85.00
2J37	12.50	725-A	WRITE
2J38	16.50	730-A	24.50

QK 60, 61, 62—$85 EA

400 CYCLE TRANSFORMERS

(All Primaries 115V, 400 Cycles)

Stock	Ratings	Price
M-7467886	2X140V/.014A, 120V/.012A, 1200 VRMS TEST, P/O MX-8/APG-2.	$ 4.95
352-7102	5.3V/2.5A	1.45
M-7472426	1450V/1MA, 2.5V/.75A, 6.4V/3.9A, 5V/2A, 6.5V/.3A, P/O ID-39/APG-13	4.95
352-7039	640VCT @ 250MA, 6.3V/.9A, 6.3V/6A, 5V/6A	$5.49
702724	9800/8600 @ 32MA	8.95
K59584	5000V/290MA, 5V/10A	22.50
KS9607	734VCT/.177A, 1710VCT/.177A	6.79
352-7273	700VCT/350MA, 6.3V/0.9A, 6.3V 2.5A 6.3V/.06A, 5V/CA	6.95
352-7070	2X2.5V/2.5A (2KV TEST) 6.3V/2.25A, 1200/1000/75 OV @ .005A	7.45
352-7196	1140V/1.25MA, 2.5V/1.75A, 2.5V/ 1.75A —5KV Test	3.95
352-7176	320VCT/50MA, 4.5V/3A, 6.3VCT/20A, 2X6.3VCT/6A	4.75
RA6400-1	2.5V/1.75A, 6.3V/2A—5KV Test	2.39
901692	13V 9A	2.49
901699-501	2.77V @ 4.25A	3.45
901698-501	900V/75MA, 100V/.04A	4.29
UX8855C	900VCT/.067A, 5V/3A	3.79
RA6405-1	800VCT/65MA, 5VCT/3A	3.69
T-48852	700VCT/80MA, 5V/3A, 6V/1.75A	4.25
352-7098	2500V/6MA, 300 VCT, 135MA	5.95
KS 9336	1100V/50MA TAPPED 625V 2.5V/5A	3.95
M-7474319	6.3V/2.7A, 6.3V/.66A, 6.3VCT/21A	4.25
KS 8984	27V/4.3A, 6.3/2.9A, 1.25V/.02A	2.95
52C080	526VCT/50MA, 6.3VCT/2A, 5VCT/2A	3.75
32332	400VCT/35MA, 6.4V/2.5A, 6.4V/.15A	3.85
68G631	1150-0-1150V	2.75
80G198	6VCT/.00006 KVA	1.75
302433A	6.3V/9.1A, 6.3VCT/6.5A, 2.5V/3.5A, 2.5V/3.5A	4.85
KS 9445	592VCT/118MA, 6.3V/8.1A, 5V/2A	5.39
KS 9685	6.4/7.5A, 6.4V/3.8A, 6.4V/2.5A ALL CT	4.79
70G30G1	600VCT/36MA	2.65
M-7474318	2100V/.027A	4.95

D.C. RELAYS

CR2792B116A3

SPST—50 Amp Contacts. Operates from 22-30 VDC. Coil Res. 200 Ohms. Completely enclosed in transparent plastic case, which may be removed for adjustments. $1.59

GE#CR2791B116W3

Same as above, except additional terminal brought out from contact arm $1.74

GE#CR2791-F100D3

Differential: DPST. Norm. open. Dual coil, 1500 ohms per coil—25 Ma. Operating Current. Contacts: 20 Amp. $2.25

GE#CR2791F100G3

Same as above, except has extra 1A contact. Rated 5 Amp. $2.35

GE#CR2791D101F3

All Ceramic Insulation, DPDT, Coil—12VDC, 100 Ohms DCR. Contacts designed for fast operation. Rated at 5 Amps. $1.25

GE#CR2791B106J3

3PDT, 5 Amp. contacts. Coil rated 22-30VDC. 150 Ohms DCR. Contacts are designed for fast operation, and enclosed by clear plastic cover $1.35

GE#CR2791B106C3

SPDT. Dual Contacts will handle 20 Amps. Coil: 18-28VDC 125 Ohms DCR $1.25

EE-89 REPEATER

Extends range of EE-8 field phone up to 20 miles of dry or wet wire operation. Extremely rugged, portable and lightweight. Uses hybrid coils and V.T. Amplifier, with extreme long-life characteristics. Brand new, complete with tube and tech. Manual, only ....

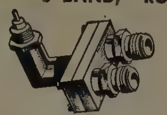
$12.75 EACH

HELMHOLTZ PHASE-SHIFTER

Stator consists of 4 loops oriented at 90 degrees to each other. Total stator inductance is 40MH. Rotor: 10MH. Total phase shift 0-360 deg. Designed for range unit of SCR-268 .... **3.95 EACH**

MICROWAVE COMPONENTS

"S BAND," RG48/U WAVEGUIDE



POWER SPLITTER for use with type 726 or any 10 CM Shepherd Klystron. Energy is fed from Klystron antenna through dual pick-up system to 2 type "N" connectors, as shown ....$22.50 EACH

DIRECTIONAL COUPLER, Broadband type "N" Coupling. 20 db. with std. flanges. Navy #CABV 47AAN-2 ....$37.50

LHTR. LIGHTHOUSE ASSEMBLY. Part of RT39 APG 5 & APG 15. Receiver and Trans. Cavities w/assoc. Tr. Cavity and Type N CPLG, To Recvr. Uses 2C40, 2C43, IB27, Tunable APX 2400-2700 MCS. Silver Plated $49.50

BEACON LIGHTHOUSE cavity 10 cm. Mfg. Bernard Rice, each $47.50

MAGNETRON TO WAVEGUIDE Coupler with 721A Duplexer Cavity, gold plated $45.00

RT-39 APG-5 10 cm. lighthouse RF head c/o Xmtr.-Recvr-TR, cavity compl. recvr. & 30 MC IF strip using 60K5 (2C40, 2C43, 1B27 lineup) w/Tubes.

721A TR BOX complete with tube and tuning plungers $12.50

McNALLY KLYSTRON CAVITIES for 707B or 2K28 ....$4.00

F 29 SPR-2 FILTERS, type "N" input and output $12.50

WAVEGUIDE TO ⅞" RIGID COAX "DOOR-KNOB" ADAPTER CHOKE FLANGE, SILVER PLATED BROAD BAND $32.50

AS14A AP-10 CM Pick up Dipole with "N" Cables $4.50

OAJ ECHO BOX, 10 CM TUNABLE $22.50

HOMERELL-TO-TYPE "N" Male Adapters. W.E. #D167284 ....$2.75

I. F. AMP. STRIP: 30 MC. 120 d.b. gain, 2 MC Bandwidth, uses 6AC7's—with video detector. Less tubes $24.50

POLYROD ANTENNA, AS31/APN-7 in Lucite Ball. Type "N" feed $22.50

ANTENNA, AT49A/APR: Broadband Conical, 300-3300 MC Type "N" Feed $12.50

"E" or "H" PLANE BENDS. 90 Deg. less flanges $7.50

⅞" RIGID COAX—⅜" I. C.

ROTARY JOINT. Stub-supported, UG 46/UG 45 fittings $27.50

10 CM STABILIZER Cavity, tunable, standard UG46/UP 45 fittings $45.00

RG 44/U RIGID COAX, stub support, 5 ft. sections, with UG46/UG45 connectors $12.50

RIGHT ANGLE BEND, with flexible coax output pickup loop $8.00

SHORT RIGHT ANGLE BEND, with pressurizing nipple $3.00

RIGID COAX to flex coax connector $3.50

RT ANGLES for above $2.50

RT. ANGLE BEND 15" L. OA $3.50

FLEXIBLE SECTION, 15 L. Male to female. .$4.25

⅞" RIGID COAX. BULKHEAD FEED-THRU $14.00

X BAND—RG 52/U WAVEGUIDE

1" x ½" waveguide in 5' lengths, UG 39 flange to UG40 cover ....**per length $7.50**

Rotating joints supplied either with or without deck mounting. With UG40 flanges ......**each, $17.50**

Bulkhead Feed-thru Assembly $15.00

Pressure Gauge Section 15 lb. gauge and press nipple $10.00

Pressure Gauge, 15 lbs. $2.50

Directional Coupler, UG-40/U Take off 20 db. $17.50

TR-ATR Uuplexor section for above $8.50

Waveguide Section 12" long choke to cover 45 deg. twist & 2½" radius, 90 deg. bend $4.50

Twist 90 deg. 5" choke to cover w/pres nipple $6.50

Waveguide Section 2½ ft. long silver plated with choke flange $5.75

Rotary joint choke to choke with deck mounting $17.50

3 cm. mitered elbow "E" plane $12.00

UG 39 Flanges $1.10

90 degree elbows. "E" or "H" plane 2½" radius $12.50

90 degree twist 6" long $8.00

UG40A/U—Broadband Choke Flange $1.65

Microwave Receiver, 3 CM. Sensitivity: 10-13 μ Watts. Complete with L.O. and AFC Mixer and Waveguide Input Circuits. 6 I.F. Stages give approximately 120 DB gain at a bandwidth of 1.7 MC. Video Bandwidth: 2 MC. Uses latest type AFC circuit. Complete with all tubes, including 723A/B Local Oscillator. $175.00

K BAND—RG 53/U WAVEGUIDE

APS-34 Rotating joint $49.50

Right Angle Bend E or H Plane, specify combination of couplings desired $12.00

45° Bend E or H Plane, choke to cover $12.00

Mitered Elbow, cover to cover $4.00

TR-ATR-Section. Choke to cover $4.00

Flexible Section 1" choke to choke $5.00

"S" Curve Choke to cover $4.50

PULSE TRANSFORMERS

UTAH X-151T-1 Dual transformer, 2 WDGS. per section 1:1 ratio per sec, 13 MH inductance 30 Ohms DCR $7.50

UTAH X-150T-1 Two section, 3 WDGS. per section 1:1:1 ratio, 3 MH, 6 Ohms DCR per WDG $7.50

68G711 Ratio, 4:1, 6.7 Ohms. Pri: 0.23 Ohms sec. $4.50

TR1049: Ratio: 2:1, Pri. 220 MH, 50 Ohms, sec. 0.75H, DCR 100 Ohms $6.75

K-901695-501 Ratio 1:1, Pri. Imp. 40 Ohm, sec. Imp. 40 Ohms. Passes pulse 0.6 USEC with 0.05 USEC rise $8.95

D-166173: Video, Ratio = 50:900 Ohms 10KC—2MC $12.50

G.E.K.-2745 ....$39.50

G.E.K.-2744-A, 11.5 KV High voltage. 3.2 KV Low voltage @ 200 KW oper. (270 KW max.) 1 microsec. or 1/4microsec. @ 600 PPS $39.50

W.E. D169271 Hi Volt input pulse Transformer ..$27.50

G.E. K2450A. Will receive 13KV, 4 micro-second pulse on pri. secondary delivers 14KV. Peak power out 100 KW G. E. $34.50

G. E. K2748A. Pulse Input line to magnetron $36.00

Ray UX 7896—Pulse Output Pri. 5v. sec. 41v ..$7.50

Ray UX 8442—Pulse inversion—40v + 40v $7.50

Ray UX 7361 ....$5.00

PHILCO 352-7250, 352-7251, 352-7287

UTAH 9332, 9278, 9341.

RAYTHEON: UX8693, UX5986 ....**$5 ea.**

W.E.: D-166310, D-166338, KS 9800, S9948

PULSE NETWORKS

15A—1-400-50: 15 KV. "A" CKT. 1 microsec. 400 PPS. 50 ohms imp. $37.50

G.E. #3E (3-84-810) .8-2.24-405) 50P4T; 3KV "E" CKT Dual Unit; Unit 1, 3 sections, 0.84 Microsec. 810 PPS, 50 ohms imp.; Unit 2, 8 Sections, 2.24 microsec. 405 PPS. 50 ohms imp. $6.50

7-5E3-1-200-67P. 7.5 KV "E" Circuit, 1 microsec 200 PPS, 67 ohms impedance 3 sections $7.50

7-5E4-16-60, 67P. 7.5 KV. "E" Circuit, 4 sections 16 microsec. 60 PPS. 67 ohms impedance $15.00

7.5E3-3-200-6FT, 7.5 KV. "E" Circuit. 3 microsec. 200 PPS. 6 ohms imp. 3 sections $12.50

#755: 10KV, 2.2usec., 375 PPS. 50 ohms imp. ..$27.50

#754: 10KV. 0.85usec., 750 PPS. 50 ohms imp. ..$27.50

KS8865 CHARGING CHOKE: 115-150H @ .02A, 32-40H @ .08A, 30,700V Corona Test, 21KV Test $37.50

G.E. 25E5-1-350-50 P2T. "E" CKT, 1 Microsec. Pulse @ 350 PPS. 50 OHMS Impedance $69.50

KS9623 CHARGING CHOKE: 16H @ 75 MA, 380 Ohms DCR, 9000 Vac test $14.95

MICROWAVE ANTENNA EQUIPMENT

AT49A/APR—Broadband Conical, 300-3300 MC. Type N Feed. (AS SHOWN) $12.50

AS-31/APN-7: 10 cm Polyrod in Lucite Ball. Type N Fitting Coax Feed. $22.50

Relay System Parabolic reflectors approx. range 2000 to 6000 Mc. Dimensions 4½" x 3'. New $100.00

Dipole for above $12.00

TDY "JAM" Radar rotating antenna, 10 cm. 30 deg. beam, 115 V AC drive. New $150.00

Parabolic Peel. Radiation pattern approx. 25 deg. in horizontal 33 deg. in vertical planes $35.00

Cone Antenna. AS 125 APR. 1000-3200 mc. Stub supported with type "N" connector $14.50

30' SIGNAL CORPS RADIO MASTS

Complete set for erection of a full flat top antenna. Of rugged plymold construction telescoping into 3 ten-foot sections for easy stowage and transportation. A perfect set-up for getting out. Supplied complete: 2 complete masts, hardware, shipping crate. Shipping wt. approx. 300 lbs. Sig. Corps No. 2A289-223-A. New ....**$49.50 per set**

AS14A/AP, 10 CM pick up dipole assy, complete w/length of coax and "N" connectors $3.50

AS46A/APG-4 Yagi Antenna, 5 element array ..$22.50

30" Parabolic Reflector Spun Aluminum dish $4.85

10 CM GUN-SIGHT ANTENNA

SPHERICAL RADOME HOUSES DRIVE MOTOR, DISH, FEED AND GUNMOUNT. **TOTAL DIAMETER:** APPROX. 15 INCHES. **DISH:** 13" DIAM. **FEED:** DIPOLE AND DISK VERTEX. **SCAN:** CONICAL AT 2400 RPM. **BEAMWIDTH:** 25°-30°. ENTIRE UNIT MAY BE PRESSURIZED UP TO 15 LBS/IN., AND ENERGY MAY BE FED BY ANY FLEXIBLE COAX CABLE. COMPLETE UNIT WITH DRIVE-MOTOR AND RADOME $325.00

THERMISTORS VARISTORS

D167018	$1.50	D172155	1.50
D167332	1.50	D167176	1.50
D167613	1.50	D168687	1.50
D166228	1.50	D167208E, D171858	1.50
D164699	2.50	308A, 27-B	1.50
D166792	2.15		
D171812	$1.50		

MAIL ORDERS PROMPTLY FILLED. ALL PRICES F.O.B. NEW YORK CITY. SEND M.O. OR CHECK. ONLY SHIPPING SENT C.O.D.
RATED CONCERNS SEND P.O. ALL MDSE. SUBJECT TO PRIOR SALE, AND PRICES SUBJECT TO CHANGE WITHOUT NOTICE.
PARCELS IN EXCESS OF 20 POUNDS WILL BE SHIPPED VIA CHEAPEST TRUCK OR RAILEX.

131 Liberty St., New York 7, N. Y. Dept I-6 Chas. Rosen Phone: Digby 9-4124

STANDARD SIGNAL GENERATOR

MODEL 65-B

RANGE 75 KC to 30 MC

Individually Calibrated Scale

OUTPUT: Continuously variable, .1 microvolt to 2.2 volts.
OUTPUT IMPEDANCE: 5 ohms to .2 volt, rising to 15 ohms at 2.2 volts.
MODULATION: From zero to 100%. 400 cycles, 1000 cycles and provision for external modulation. Built-in, low distortion modulating amplifier.
POWER SUPPLY: 117 volts, 50-60 cycles, AC.
DIMENSIONS: 11" high, 20" long, 10¼" deep, overall.
WEIGHT: Approximately 50 lbs.

Catalog on request

MANUFACTURERS OF
Standard Signal Generators
Pulse Generators
FM Signal Generators
Square Wave Generators
Vacuum Tube Voltmeters
UHF Radio Noise & Field Strength Meters
Capacity Bridges
Megohm Meters
Phase Sequence Indicators
Television and FM Test Equipment

MEASUREMENTS CORPORATION
BOONTON NEW JERSEY

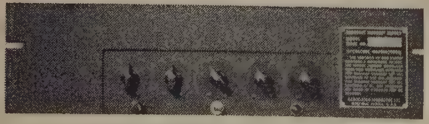
TOP HAT FOR PLUG-IN UNITS

A widely used, dependable, improved clamp for electron tubes, relays and capacitors.

WRITE FOR 1953 CATALOG

EASY TO APPLY
INSTANTLY RELEASED
POSITIVE LOCKING ACTION

TIMES FACSIMILE CORPORATION
540 West 58 St., New York 19, N. Y.
1523 L St., N.W. Washington 5, D. C.


RACK MOUNTING MODELS

THIS IS THE SUPPLY IN WHICH THE OUTPUT VOLTAGE VARIES TO HOLD THE LOAD CURRENT CONSTANT.

DESIGNED FOR PRODUCTION TESTING, RESEARCH, INSTRUMENTATION, AND CALIBRATING USE.

STANDARD MODELS ARE AVAILABLE TO COVER THE CURRENT RANGE OF 0.2 TO 100 M.A. IN ONE INSTRUMENT.

ELECTRONICALLY REGULATED
D.C. CONSTANT CURRENT POWER SUPPLIES

OUTPUT CURRENT IS HELD CONSTANT AS LOAD VARIES

OTHER MODELS AVAILABLE
WRITE DEPT. 101 FOR LITERATURE

ASSOCIATED SPECIALTIES CO.
1751 MAIN STREET
OREFIELD, PENNSYLVANIA

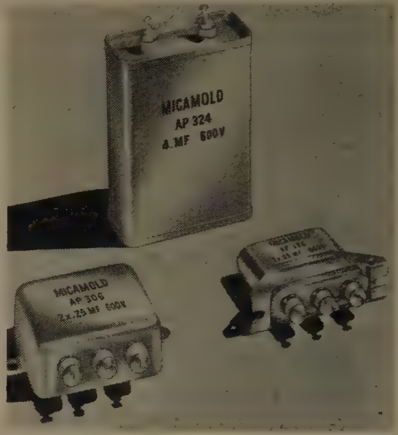
News—New Products

These manufacturers have invited PROCEEDINGS readers to write for literature and further technical information. Please mention your I.R.E. affiliation.

(Continued from page 154A)

Hermetically Sealed Capacitors

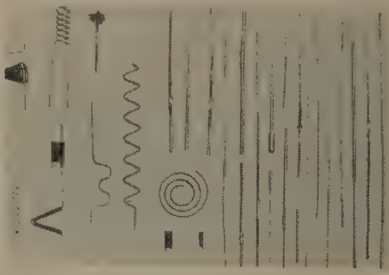
Micamold Radio Corp., 1087 Flushing Ave., Brooklyn 37, N. Y., is now manufacturing hermetically sealed, metal encased Ambirite capacitors. These capacitors were developed for satisfactory operation in ambient temperatures up to 150°C.



These capacitors can be supplied with single and dual sections in standard capacitance values and voltage ratings in various case sizes. They have the ability to operate throughout the temperature range of −55°C to +150°C which is attributed to Ambirite, a dielectric developed by Micamold. Capacitance change with temperature is small. The special Porcalum solder-sealed terminals have the mechanical and electrical characteristics necessary to withstand the severe thermal conditions to which military equipment is exposed. An engineering bulletin will be mailed upon request.

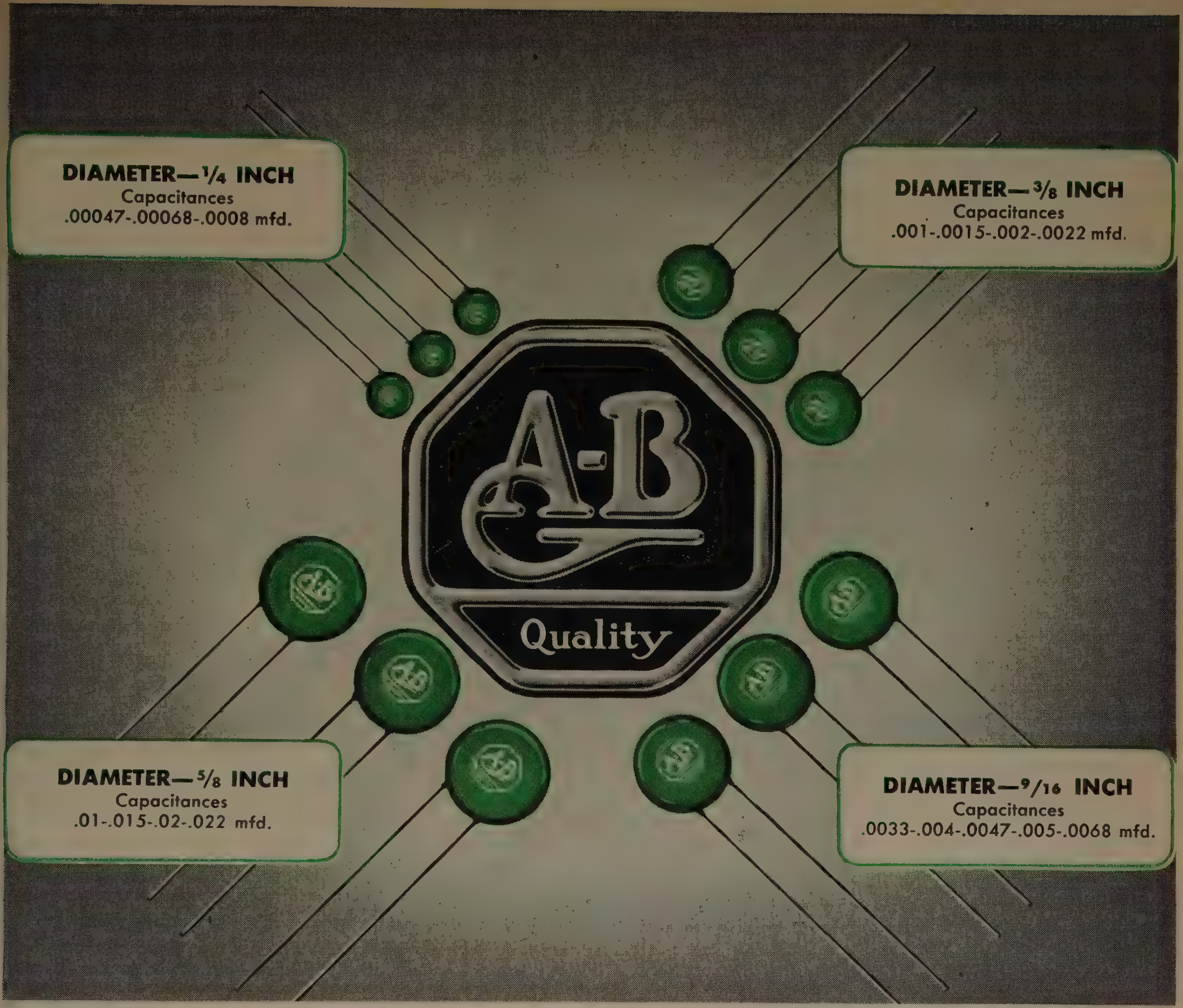
Tungsten and Moly Coils

Coils of tungsten and molybdenum, hand-wound to exacting standards, are among the many components now being fabricated for electronic applications by **Electronic Parts Manufacturing Co., Inc.,** 540 39 St., Union City, N. J.



These hand-wound coils are made to customers' specifications and are intended for use as emitters, filaments, coiled coils as well as for other electronic applications.

Leads of uniform quality, with or without beading, are another group of products fabricated by Electronic Parts from tungsten, molybdenum, nickel, nickel-clad copper and alloys.



HIGH QUALITY CERAMIC CAPACITORS

Scientific supervision is maintained at every step in the production of Allen-Bradley ceramic capacitors. Starting with the compounding of the materials for the ceramic discs and continuing, step by step, through the molding, sintering, silvering, soldering, and wax impregnating of the finished capacitors . . . every operation is under Allen-Bradley precision control. A quality product is the consistent result.

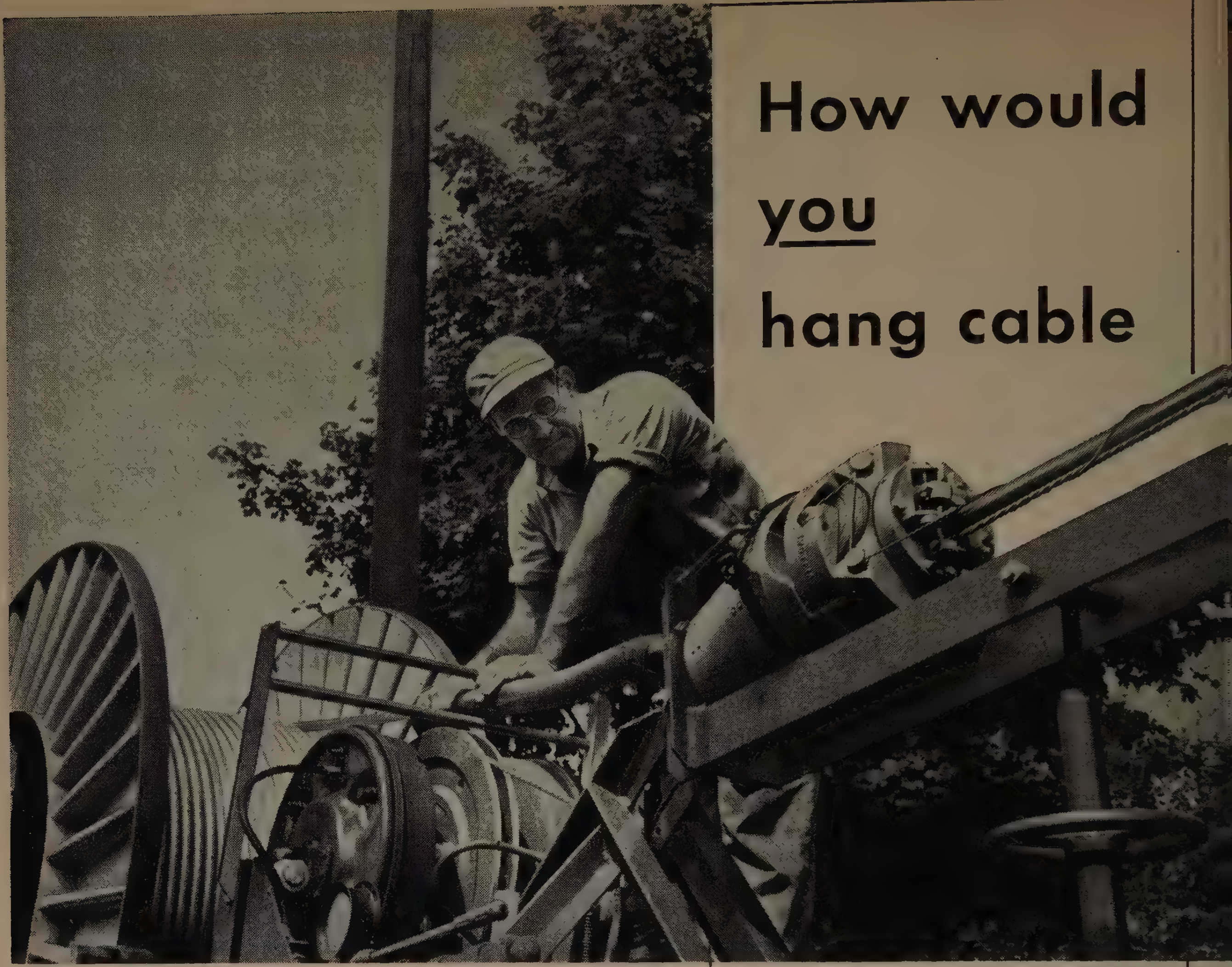
Allen-Bradley capacitors are made in four sizes with a range of .00047 to .022 mfd. Minimum capacitance values are guaranteed over a temperature range from plus 10C to plus 65C. Since the ceramic discs of high K dielectric are molded and sintered in the Allen-Bradley factory, not only is the production of an ample supply of ceramic discs assured but the uniformity of the finished capacitors can be rigidly maintained at all times under Allen-Bradley production controls. Because of their uniformity of quality and performance, Allen-Bradley ceramic capacitors have been approved by the engineering departments of the largest electronic, electrical, and telephone laboratories.

Allen-Bradley makes its own Ceramic Discs

Specify Allen-Bradley ceramic capacitors . . . they are as dependable as the well-known Allen-Bradley resistors and potentiometers. The A-B trademark is your guarantee of quality capacitors. Samples will be furnished on request for qualification tests and type approval.

Allen-Bradley Co., 114 W. Greenfield Ave., Milwaukee 4, Wis.

ALLEN-BRADLEY
RADIO & TELEVISION COMPONENTS
QUALITY



How would *you* hang cable

Cable lasher appears to right of workman. As the cable and supporting strand feed through, the machine rotates, binding them together with steel lashing wire. Meanwhile, a winch hauls the lashed cable into position.

...by the mile?

It is a job your telephone company faces every day. Thousands of miles of cable go up each year—all secured to steel strand running from pole to pole. The best way to secure cable is to *lash* it to the strand with a spiral binding of wire.

One way to do this is to raise cable and strand separately, then lash them together by a rotating machine pulled along by workmen on the ground. This produces a strong, tight support for the cable. But each pole has to be climbed as many as four times. So Bell Laboratories engineers devised an easier way.

Now, lashing can be done *on the ground* so that cable, strand and lashing wire may be pulled into position as a complete assembly. Usually workmen need make only two trips up each pole.

For telephone users, the new way means that cable can be installed faster, while costs are kept down. It shows again how work at Bell Telephone Laboratories improves each part of your telephone system.

Bell Telephone Laboratories

AMERICAN TELEPHONE & TELEGRAPH CO. BELL SYSTEM AND ASSOCIATED COMPANIES

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN MECHANICAL ENGINEERING

RAYTHEON

FLAT PRESS
HEATER-CATHODE TUBE NEWS

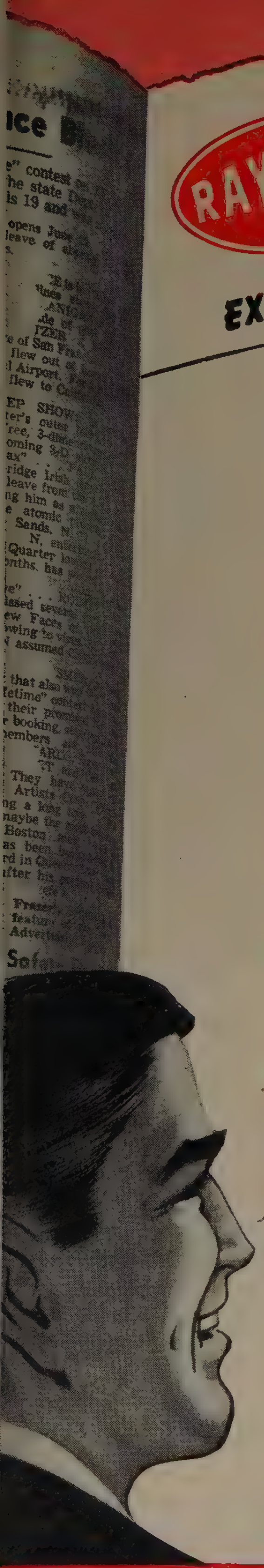
RAYTHEON

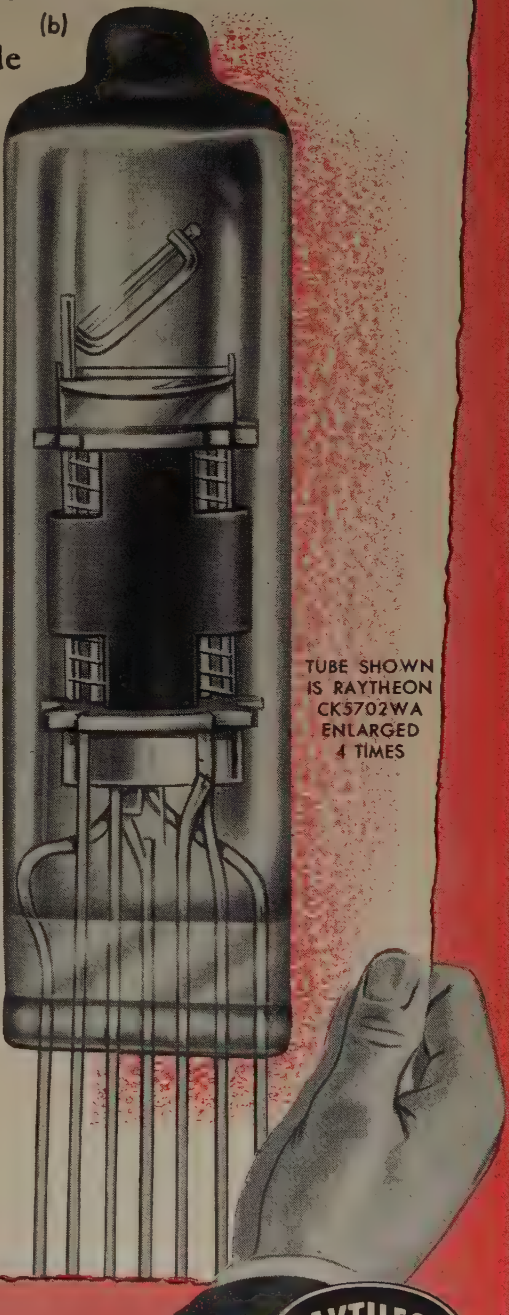
EXTRA

EXTRA

You get all these "extras" when you use Raytheon Flat Press Heater-Cathode Subminiature Tubes:

1. **Higher Plate Voltage Ratings**
2. **Wider Heater Voltage Ratings**
3. **Superior Low Heater Voltage Performance**
4. **Lower Thermal and Shot Noise**
5. **Higher Ambient and Bulb Temperature Ratings**
6. **Lower Vibrational Noise Output**
7. **Longer Shelf Life**
8. **Reduced Air Leakers — Longer Dumet Seal** (a)
9. **Molded Tips** (b)





TUBE SHOWN IS RAYTHEON CK5702WA ENLARGED 4 TIMES

Data sheets for these Tubes and information on other Raytheon Subminiature Tubes may be obtained from your nearest Raytheon Tube Distributor or from any of the Raytheon offices listed below.

RAYTHEON

Excellence in Electronics

RAYTHEON MANUFACTURING COMPANY

Receiving Tube Division — for application information call

Newton, Mass. Bigelow 4-7500 • Chicago, Ill. NAtional 2-2770 • New York, N. Y. WHitehall 3-4980 • Los Angeles, Calif. Richmond 7-5524

RAYTHEON MAKES ALL THESE

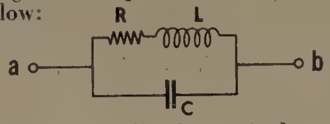
RELIABLE SUBMINIATURE AND MINIATURE TUBES • GERMANIUM DIODES AND TRANSISTORS • NUCLEONIC TUBES • MICROWAVE TUBES • RECEIVING AND PICTURE TUBES

WHAT ABOUT

Frequency Response

IN *PRECISION WIREWOUND* RESISTORS

Precision wirewound resistors have residual parameters that change the resistor from a simple resistance to a complex impedance which is a function of frequency. The effective resistance and reactance of a precision wirewound resistor can be computed from a knowledge of the parameters in the equivalent circuit below:



The d-c resistance is R, the equivalent inductance in series with the resistor is L, and C is the equivalent capacitance in parallel with the resistor. With L and C small, as they usually are, it can be shown that:

$$\underline{Z}_{ab}=\sqrt{R_e^2+X_e^2}\,\underline{/\Theta} \qquad \omega=2\pi f$$

$$R_e \cong R[1+\omega^2 C(2L-CR^2)] \qquad X_e \cong \omega(L-CR^2)$$

$$\tan\Theta \cong \frac{X_e}{R}$$

where Z_{ab} is the impedance at terminals a-b, R_e is the effective resistance, X_e is the effective reactance, and Θ is the resistor phase angle. From these expressions it is apparent that:

1. The effective resistance will be constant and independent of frequency only if C=O. This does *not* make the phase angle or the reactance zero. **2.** The condition for zero reactance and zero phase angle is the same, $L=CR^2$. However, the resistance still varies with frequency when this condition is met. **3.** Zero phase angle, zero reactance, and constant resistance with frequency are achieved simultaneously only when both L and C are zero.

PRODUCTION RESISTORS AND FREQUENCY RESPONSE: Ninety percent or more of the precision wirewound resistors manufactured by the industry are the reversed section or "pi" type. In the range below about 100 ohms the series inductance L predominates. In the range above about 2,000 ohms the shunt capacitance C predominates. In between, both parameters must be considered.

In standard resistor production, desired parameters can often be obtained by varying wire size, bobbin size, number of turns, number of sections or pies, and, to a lesser extent, by varying termination and impregnant. In this way the parameters are predictable at only slight extra cost, barring difficulties due to too large or small a wire size for the resistor value or a need for an entirely new bobbin design. It is unlikely, if not impossible, that any variation in reversed-pi construction can ever make an inherently capacitive high ohmic value resistor inductive or an inherently inductive low ohmic value resistor capacitive. For a given resistance value the possible variation of parameters cannot achieve the desirable conditions C=O and/or L=O. It might be possible by selection to achieve the condition $L=CR^2$ for a particular resistor value, but this could not be done on a production basis. For most values it would not be possible even by selection.

For a given resistance value with the parameters known, the user can often add capacitance or inductance to compensate and achieve zero phase angle—zero effective reactance. However, the effective resistance still varies with frequency and compensation is obtained at only one frequency.

RESISTANCE ERROR WITH FREQUENCY: For high ohmic value resistors with C predominant, the effective resistance will be less than the d-c resistance; with L predominant, the effective resistance will be more than the d-c resistance. The actual percentage error in resistance defies simple expression. For a given resistor it is a function of frequency, but unless the resistor has been compensated to zero reactance, effective impedance rather than resistance should be considered. For a 1,000 ohm resistor in the 1″ x ½″ commercial 1-watt size, X_e/ω can be as high as 100μh. A 10,000 ohm resistor of the same size may have an X_e/ω negative and equivalent to only several micro-microfarads.

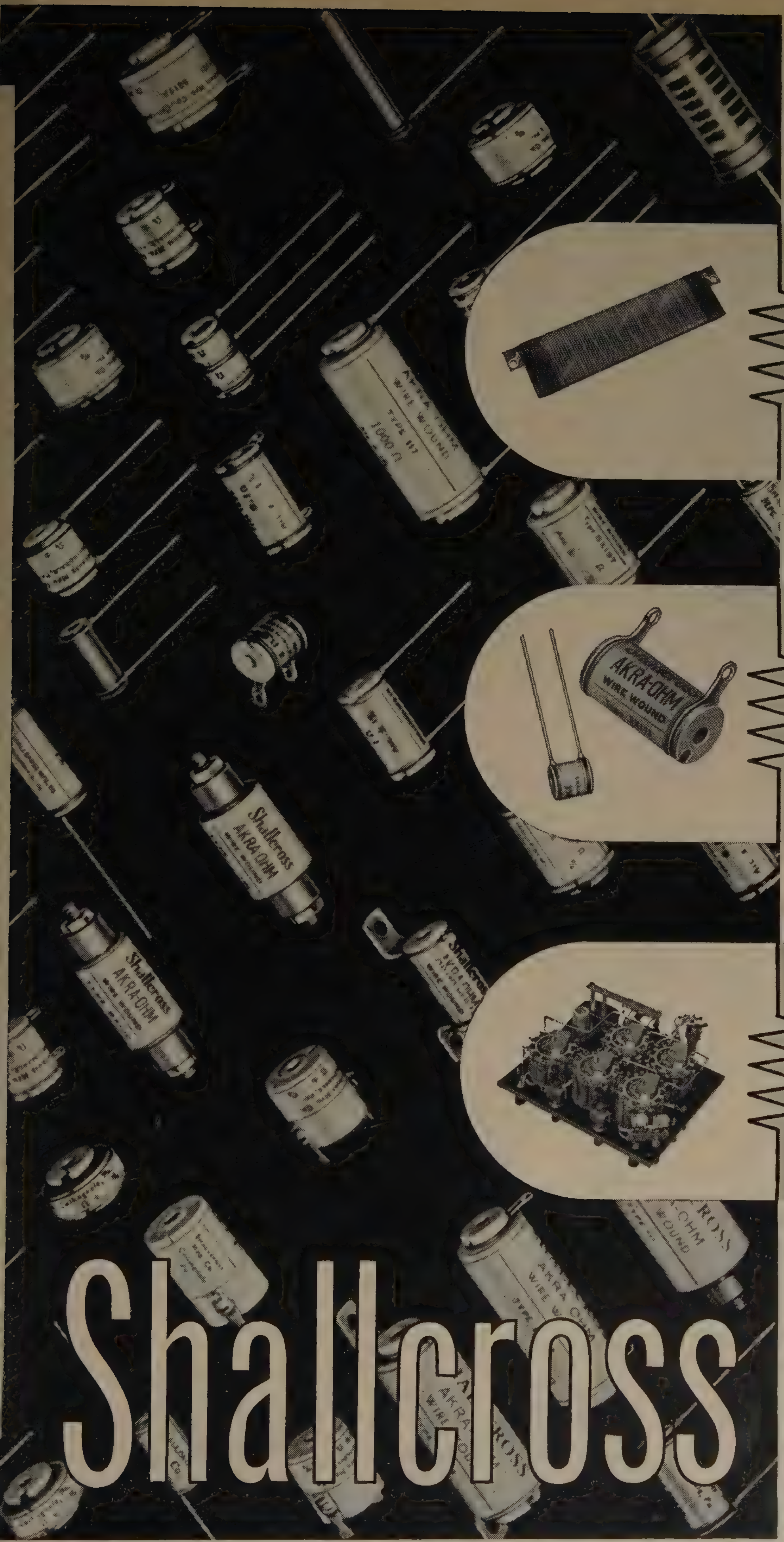
This is a very important design consideration. The location and mounting of the resistor and associated wiring can often contribute more capacitance and occasionally more inductance than is residual in the resistor.

Often the only solution to the residual parameter problem is the use of other than a conventional reversed-pi wound bobbin. Shallcross can supply many other types of windings on special order—each with its own special frequency characteristics.

Further details on Frequency Response and other resistor characteristics are available in Shallcross Bulletin R-3C.

SHALLCROSS MANUFACTURING COMPANY • 524 PUSEY AVENUE, COLLINGDALE, PA

The fourth of a series to promote a better understanding of the performance characteristics of precision wirewound resistors.



NON-INDUCTIVE SURGE RESISTOR

The Shallcross Type R-9073 high voltage precision card resistor has an Ayrton-Perry winding to obtain residual inductance of only a few micro-henries below 1,000 ohms. Resistances from 5 to 1,000 ohms available. Standard tolerance 1%.

STANDARD REVERSED-PI RESISTOR

Standard Shallcross resistors have reversed-pi windings. The inductance of this type of winding decreases below 1,000 ohms. Above 10,000 ohms the winding becomes increasingly capacitive.

BIFILAR WINDING FOR INSTRUMENT RESISTORS

Shallcross Type 245-S resistors are mounted on the switch decks of the Shallcross Type 6100 Wheatstone Bridge shown at left. Available in values up to 1,000 ohms, their low inductance makes these resistors ideally suited for precision instruments.

Ketay gives you a complete variety of sizes and types of Synchros and Servo Motors

WHATEVER THE NEED
CHOOSE KETAY!
Available as listed

1. SYNCHRO, Size 16, O.D. 1.537", 115 V, 400 Cycles *(Transmitter, Receiver, Control Transformer)*
2. INDUCTION MOTOR, O.D. 1.750", 3 phase 2 Pole, 115 V, 60 Cycles
3. SYNCHRO, Size 18, O.D. 1.750", 115 V, 400 and 60 Cycles *(Transmitter, Receiver, Differential, Control Transformer)*
4. SERVO MOTOR, O.D. .937", 26V, 400 Cycles
5. SYNCHRO, O.D. 1.437", 14.4 V and 26 V, 400 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
6. SERVO MOTOR Mk 7, O.D. 1.437", 115 V, 400 Cycles
7. SYNCHRO, Type 1F or 1HG, O.D. 2.250" 115 V, 60 Cycles *(Receiver, Transmitter)*
8. SYNCHRO, Size 31, O.D. 3.10", 115 V 400 and 60 Cycles *(Transmitter, Receiver, Differential, Control Transformer)*
9. SYNCHRO, Size 23, O.D. 2.250", 26 V and 115 V 400 & 60 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
10. SYNCHRO, O.D. .937", 26 V, 400 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
11. LINEAR TYPE CONTROL TRANSFORMER, O.D. 1.625", 26 V, 400 Cycles
12. SYNCHRO, Size 11, O.D. 1.062", 26 V and 115 V, 400 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
13. SERVO MOTOR, O.D. 1.062", 115 V, 400 Cycles
14. SYNCHRO, Size 15, O.D. 1.437", 26 V and 115 V, 400 Cycles *(Transmitter, Receiver, Resolver, Differential, Control Transformer)*
15. SYNCHRO, Size 19, O.D. 1.90", 115 V, 400 Cycles *(Transmitter, Receiver, Control Transformer)*

KETAY offers high precision rotary and instrument components for most every need in the Armed Forces and Industry. As the world's largest producer of government approved synchros, Ketay stands ready to solve your problems with a complete line of synchros, servos, magnetic amplifiers, computers and control systems.

If you are searching for a specific size or type... if availability is a problem... if engineering counsel is needed... Ketay can help. Why not join us for an exploratory discussion of your particular problem. Write today to Dept. A

Ketay **MANUFACTURING CORP.**
555 Broadway, New York 12, N. Y.

KINETIX INSTRUMENT DIV.
RESEARCH & DEVELOPMENT DIV.
PACIFIC DIVISION
12833 Simms Ave., Hawthorne, Calif.

DESIGN
DEVELOPMENT
MANUFACTURE ...*of precision instruments, components, and systems.*

NEW . . SMALLER . .

. . LIGHTER WEIGHT LINE SWITCHES

Here's real line switching versatility for Stackpole Types LP, LR and other standard variable composition resistors! These little switches measure only 7/8" diameter by 9/32" deep, exclusive of terminals.

Six standard types fill virtually every line switching need—from a low torque model for midget radios with small knobs, to a heavy duty SP DT type for large combination receivers and television sets. For auto radio and similar applications, there is a new high-current, low-voltage type with doubly anchored terminals that really takes the stress of heavy wires.

Write for Stackpole Switch Bulletin.

DP ST 3 AMPS., 125 V.; 1 AMP., at 250 V. AC-DC. U.L. Approved ***Type* A-10**

SP ST 5 AMPS., 125 V. AC. With or without dummy terminal. U.L. Approved . . . ***Type* A-11**

DP ST 12 AMPS., 12 V. DC. Ideal for mobile radios. ***Type* A-12**

SP DT 3 AMPS., 125 V. AC-DC. For combined line switching and B+ discharge in large radio or TV receivers . . . . . ***Type* A-13**

DP ST LOW TORQUE TYPE, 1 AMP., 125 V. AC-DC. U.L. Approved . . . . ***Type* A-15**

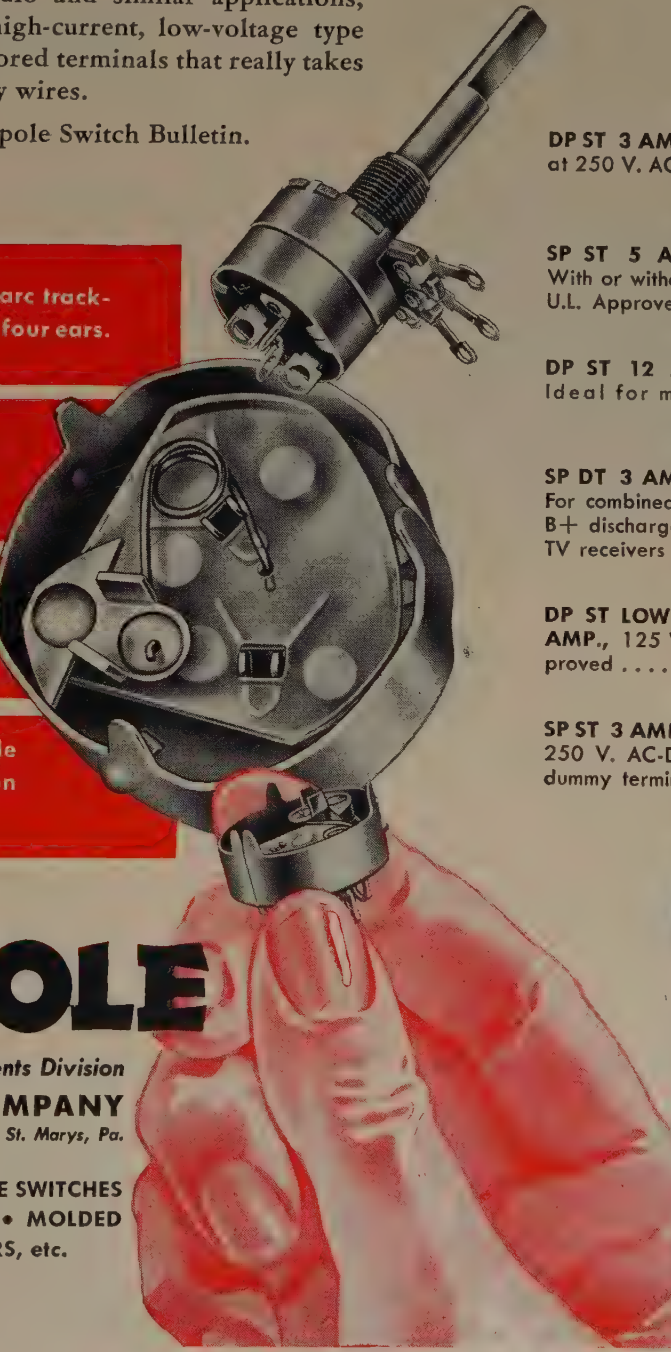
SP ST 3 AMPS., 125 V.; 1 AMP., 250 V. AC-DC. With or without dummy terminal. ***Type* A-16**

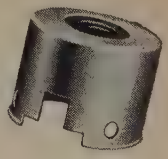
Laminated Bakelite base for reduced arc tracking. Securely locked to switch case by four ears.

Unique design prevents solder from reaching switch mechanism.

Tinned terminals—doubly locked in position by ears and rivets.

Silver-plated stationary and movable contacts give increased wiping action and positive indent.





U.L. APPROVED SWITCH COVER *is available for above switches.*

STACKPOLE

Electronic Components Division
STACKPOLE CARBON COMPANY
St. Marys, Pa.

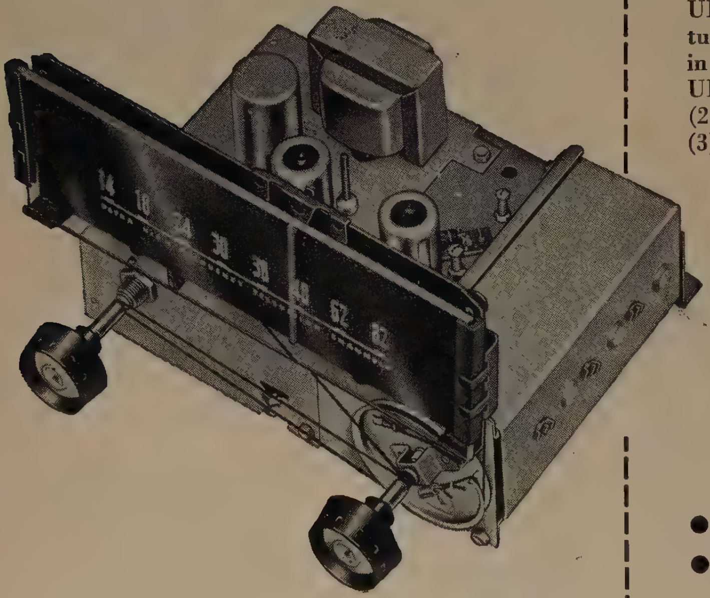
FIXED & VARIABLE RESISTORS • LINE & SLIDE SWITCHES CERAMAG® FERRITE CORES • IRON CORES • MOLDED COIL FORMS • "GIMMICK" CAPACITORS, etc.

Why the Mallory **UHF** Tuner Should be Part of Your New TV Plans

The Mallory UHF Tuner can be the complete answer to your UHF tuning problems . . . whether you build converters, all-channel receivers, or both. It consists of three sections of variable inductance. It covers the range between 470 and 890 megacycles with approximately 2 mmf of shunt capacity. Selectivity is excellent over the entire band.

No matter how you decide to handle the problem of UHF reception, it will pay you to investigate the various possibilities offered by the Mallory UHF Tuner. One of the following combinations is the answer to your requirements . . .

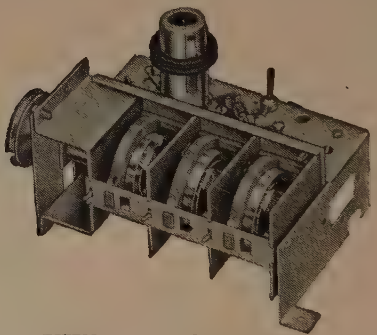
FOR CONVERTERS . . .



- Mallory UHF Tuning element for manufacturers building their own converters.
- Mallory UHF Converter chassis . . . ready to mount in your cabinet.
- Complete Mallory UHF Converter with your brand label.

FOR RECEIVERS . . .

UHF Tuners, for use in combination with VHF tuners, are available in 3 different designs . . . each in 3 different stages of assembly: (1) To convert UHF signals to 82 megacycles on channels 5 or 6. (2) To convert UHF signals to 130 megacycles. (3) For operation into a 41 megacycle IF amplifier.



- Mallory UHF tuning element.
- Mallory RF assemblies. This includes the tuner, oscillator, tube, crystal and associated circuitry.
- Mallory RF assemblies with an IF amplifier operating at conversion frequency.

Get in touch with us regarding the Mallory UHF Tuner. We will be glad to work with you . . . see how these various possibilities can be fitted into your plans for UHF television. Write today.

Television Tuners, Special Switches, Controls and Resistors

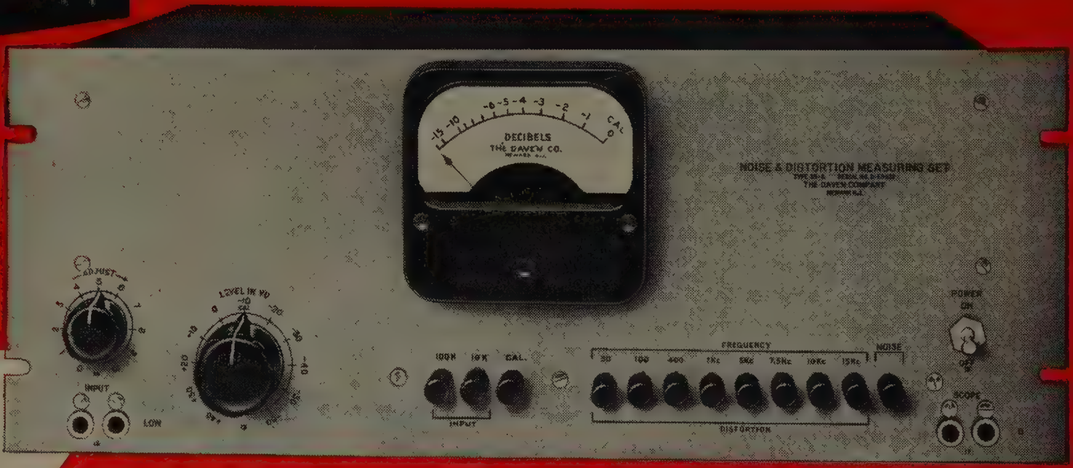
P. R. MALLORY & CO. Inc.
MALLORY

SERVING INDUSTRY WITH THESE PRODUCTS:
Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Dry Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

P. R. MALLORY & CO., INC., INDIANAPOLIS 6, INDIANA

It's that Simple...

...Automatic Push-Button Tuning



An Exclusive Feature of the New

DAVEN

Distortion and Noise Meter Type 35-A

The DAVEN Type 35-A, Distortion and Noise Meter, is a new, skillfully engineered instrument that provides a rapid, accurate means of measuring distortion, noise and hum level in audio frequency equipment.

Of particular importance is the fact that there is no balancing or laborious time consuming tuning required to make measurements. The user need only push a button and the unit is automatically balanced.

This is accomplished by the use of a series of 8 fixed band rejection filters covering the range 50 cycles to 15 K.c., followed by a stable, high quality, wide range (50 cycles to 45 K.c.), high gain amplifier. There are no tube circuits or other sources of inherent distortions, making it possible to measure low levels of distortion accurately over a wide level range.

SPECIFICATIONS

RESIDUAL DISTORTION: No tube circuits or non-linear devices between input of set and filter input.

DISTORTION MEASUREMENTS: Filters provided for 50, 100, 400, 1000 cycles, 5 Kc, 7.5 Kc, 10 Kc, and 15 Kc with cut off of −70 db. Distortion measurements to 0.1% full scale meter deflection with zero level input.

NOISE MEASUREMENTS: With zero db input, limit is −80 db. At +40 input, limit is −115 db below input.

AMPLIFIER FREQUENCY RANGE: 50 cycles to 45 Kc.

ACCURACY: Filters are down 70 db at fundamental frequencies, and within ±0.5 db of flat response at the second harmonic. Absolute accuracy of measurement can be depended upon to be within ±5%.

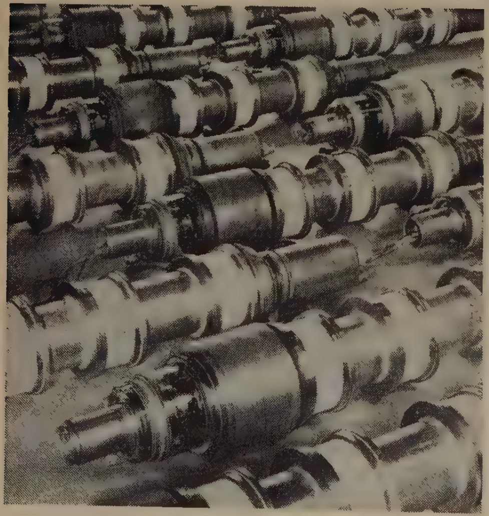
RESIDUAL NOISE LEVEL: Below −80 db at gain control full on. Multiple gain control employed so that residual noise drops to −90 db. when gain control is set at −30, −100 db when gain control is set at −20, etc.

Write for detailed information

THE **DAVEN** CO.
195 CENTRAL AVENUE
NEWARK 4, N. J.

3 EIMAC KLYSTRONS FOR ALL UHF-TV

3K20,000LA — CHANNELS 14-32
3K20,000LF — CHANNELS 33-55
3K20,000LK — CHANNELS 56-83



Eimac 5 kw Klystrons Offer These Features for UHF-TV. . .

THREE TUBES that cover the entire spectrum, 470-890 mc. This means simplification of equipment design, economical mass production and a minimum of stock piling problems.

HIGH POWER AND SMALL SIZE that not only makes top performance possible but allows easy handling for maintenance and installation. In typical operation the Eimac klystrons deliver a peak sync output of 5.5 kw., with a collector dissipation of 14 kw., and a power gain of 20-25 db.

MASS PRODUCTION that means early delivery and guarantee of klystrons in the future. All three of the series are now coming off the production line.

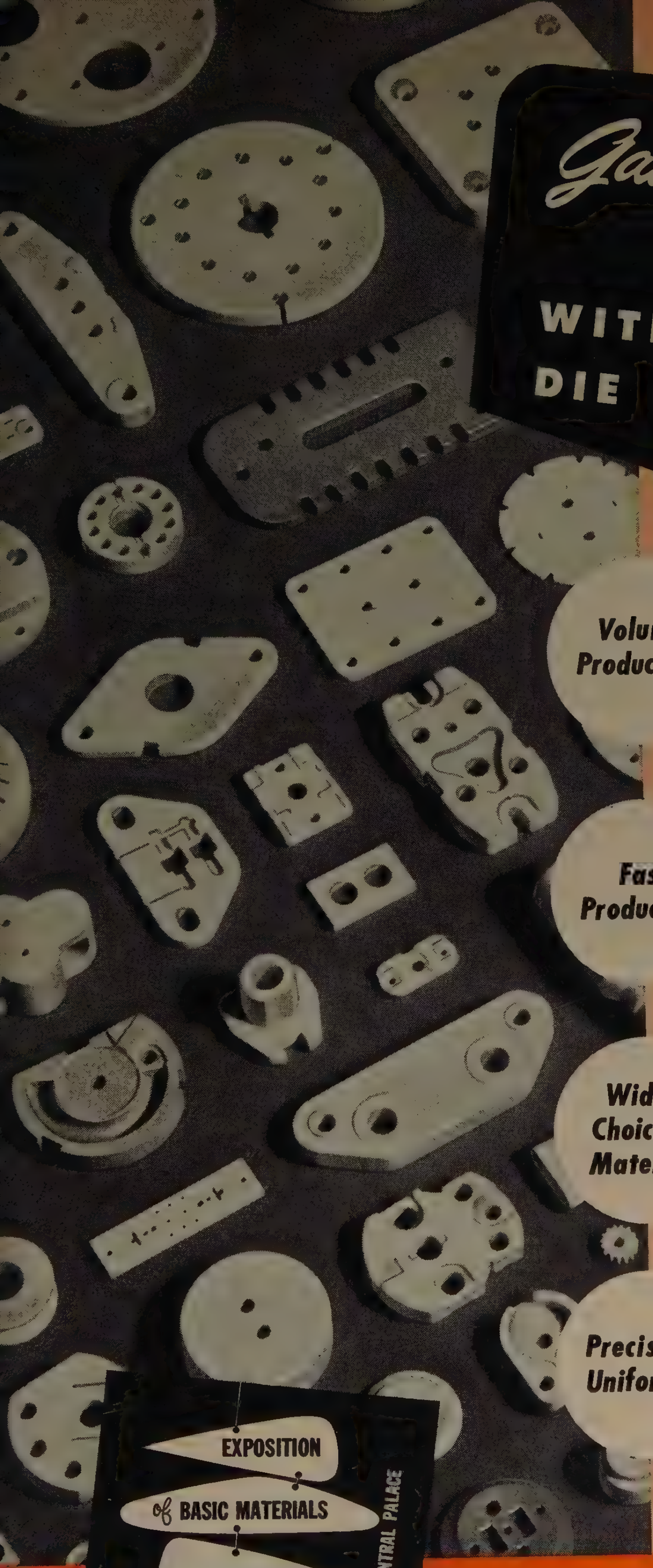
EXTERNAL TUNING that increases the tuning range; eliminates mechanical distortion of tube structure; permits use of optimum cavity construction and provides design freedom in R-F circuits for equipment engineers.

LOW-LOSS CERAMIC CAVITIES AND COPPER-TO-CERAMIC SEALS that eliminate off-the-air hours caused by heat and thermal shock.

FOR FURTHER INFORMATION CONTACT OUR TECHNICAL SERVICES DEPARTMENT.

EITEL-McCULLOUGH, INC.
SAN BRUNO, CALIFORNIA
Export Agents: Frazar & Hansen, 301 Clay St., San Francisco, California

Eimac
REG. U.S. PAT. OFF.
TUBES



Gain these advantages WITH ALSIMAG® DIE PRESSED CERAMICS

Volume Production

Your parts can be run on the equipment that produces the desired volume at lowest cost. We have the most complete automatic press facilities in the industry.

Fast Production

Press equipment ranges from small tabletting presses to 100 ton hydraulics and includes several high speed rotaries. Any one of these rotaries can produce up to 1,800,000 a day of small, simple parts.

Widest Choice of Materials

You can choose the AlSiMag ceramic composition with the physical characteristics best suited for your requirements. Property chart, free on request, gives characteristics of the many compositions available. Engineering advice is available on request.

Precision... Uniformity

AlSiMag die pressed ceramics are uniform physically and dimensionally. This speeds assembly, assures dependable performance. Where exceptional dimensional accuracy is required, grinding facilities are available at commensurate cost.

EXPOSITION
of BASIC MATERIALS
FOR INDUSTRY
JUNE 15-19, 1953, NEW YORK
GRAND CENTRAL PALACE

BOOTH NO. 71

52ND YEAR OF CERAMIC LEADERSHIP

AMERICAN LAVA CORPORATION

CHATTANOOGA 5, TENNESSEE

OFFICES: METROPOLITAN AREA: 671 Broad St., Newark, N. J., Mitchell 2-8159 • SYRACUSE, N. Y.: 330 Arlington Ave., Phone 76-5068 • CLEVELAND: 5012 Euclid Ave., Room 2007, Express 1-6685 NEW ENGLAND: 1374 Mass. Ave., Cambridge, Mass., Kirkland 7-4498 • PHILADELPHIA: 1649 N. Broad St., Stevenson 4-2823 • ST. LOUIS: 1123 Washington Ave., Garfield 4959 CHICAGO: 228 N. LaSalle St., Central 6-1721 • SOUTHWEST: John A. Green Co., 6815 Oriole Dr., Dallas 9, Dixon 9918 • LOS ANGELES: 5603 N. Huntington Dr., Capital 1-9114

PERMANENT MAGNETS and ASSEMBLIES for Magnetrons and Traveling Wave Tubes

The group of magnets illustrated above, weighing from a fraction of a pound up to 75 pounds, are indicative of the wide range of Arnold production in this field. We can supply these permanent magnets in any size or shape you may need, with die-cast or sand-cast aluminum jackets, Celastic covers, etc. Complete assemblies may be supplied with Permendur, steel or aluminum bases, inserts and keepers as specified . . . magnetized and stabilized as desired. ● *Let Arnold handle your magnetron and traveling wave tube permanent magnet requirements.*

Made to your Specifications

. . . ANY SIZE, SHAPE OR COATING REQUIRED

★ *We'll welcome your inquiries*

W&D 4698

THE ARNOLD ENGINEERING COMPANY

SUBSIDIARY OF ALLEGHENY LUDLUM STEEL CORPORATION
General Office & Plant: Marengo, Illinois
DISTRICT SALES OFFICES
New York: Empire State Bldg. Los Angeles: 3450 Wilshire Blvd.

Laboratory Model

HICKOK

PORTABLE

TUBE TESTER

Model 539A

Electronic Development Engineers . . . you men who create and build todays electronic miracles, depend heavily on the keystone component—the vacuum tube.

HICKOK pioneered the first commercial tube testers with Dynamic Mutual Conductance circuits. This circuit, long recognized as the true evaluation of a vacuum tube, is available only in equipment bearing the HICKOK trademark.

The laboratory portable shown is one of eleven models available . . . all expertly engineered with specific features for every specialized need.

THE HICKOK ELECTRICAL INSTRUMENT COMPANY

10514 Dupont Avenue • Cleveland 8, Ohio

NOW YOU CAN HAVE the Tungsten and Chemical Components that help make Sylvania Picture Tubes so popular

Seven out of the ten leading television set makers are today using Sylvania Picture Tubes. Why this overwhelming popularity? Much of the credit will be found in the splendid quality and scientific purity of Sylvania's Tungsten and Chemical Components. And NOW, these products, based on 15 years research and special skills, are offered to you! *For example:*

Picture Tube Phosphors by Sylvania are superior because they are carefully controlled for particle size, brightness, and uniformity of color. Sylvania offers a number of these quality phosphors for black and white television. Of special interest is the phosphor blended for maximum cross-burn resistance. Also available are phosphors for color television picture tubes and cathode ray tubes. All may be obtained in 1000 lb. lots to eliminate any color-matching problems.

Potassium Silicate is produced by Sylvania with exact control of the ratio of the two elements involved, thus assuring optimum wet-screen strength. Its high chemical purity helps maintain screen brightness and good color. Each container of this Sylvania quality chemical guaranteed to contain 28% total solids.

Stranded Tungsten Coils for Vacuum Metalizing. With Sylvania Tungsten Coils, you can depend on highest performance at lowest cost. These stranded coils provide a uniform deposit of metal where needed. They're sturdy too . . . reduce mechanical breakage in the loading of filaments. Sylvania Tungsten Coils also give you more shots from each filament, and the best heat for evaporation.

Tungsten Wire for Cathode Heaters. Sylvania controls and quality checks its tungsten wire production, from ore to finished product. With Sylvania Tungsten Wire, you can be sure of good retention of shape and other desirable characteristics after treating and coating.

Triple Carbonate Cathode Emission Coatings. These Sylvania coatings comply with the highest standards of purity. Made by Sylvania's improved methods, these coatings are offered in a range of exact chemical compositions and particle sizes to meet the requirements of any manufacturer.

We'll be happy to send you full information concerning the complete line of Sylvania Tungsten and Chemical Components. Address your inquiries to: Sylvania Electric Products Inc., Dept. 3T-4506, 1740 Broadway, New York 19, N. Y.

SYLVANIA

TUNGSTEN & CHEMICAL PRODUCTS; RADIO TUBES; TELEVISION PICTURE TUBES; ELECTRONIC PRODUCTS; ELECTRONIC TEST EQUIPMENT; FLUORESCENT LAMPS, FIXTURES, LIGHT BULBS; PHOTOLAMPS; TELEVISION SETS

THE COLLINS OMNIRANGE NAVIGATION RECEIVER

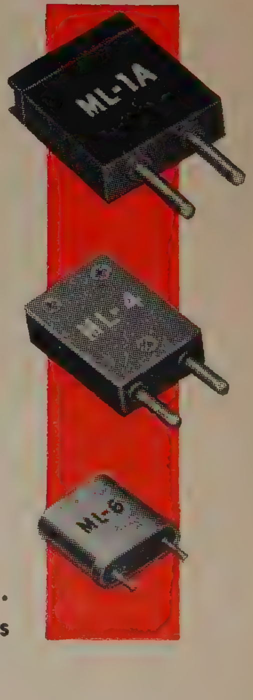
Is the Heart of the Famous Collins Navigation System

The Collins 51R-3 Navigation Receiver is typical of the outstanding developments of the Collins Radio Company for aviation, navigation, and communication. It is in wide use among airlines, private, and military planes. With accessories, it is the heart of the Collins navigation system to which is entrusted the efficient and safe operation of every type aircraft.

Midland CRYSTALS Play a Vital Role

Midland Crystals are entrusted with the exacting job of frequency control in the Collins 51R-3. Thirty-four crystals provide complete 280-channel coverage. In such critical service, there can be no compromise with quality, precision, and undeviating performance under every operating stress.

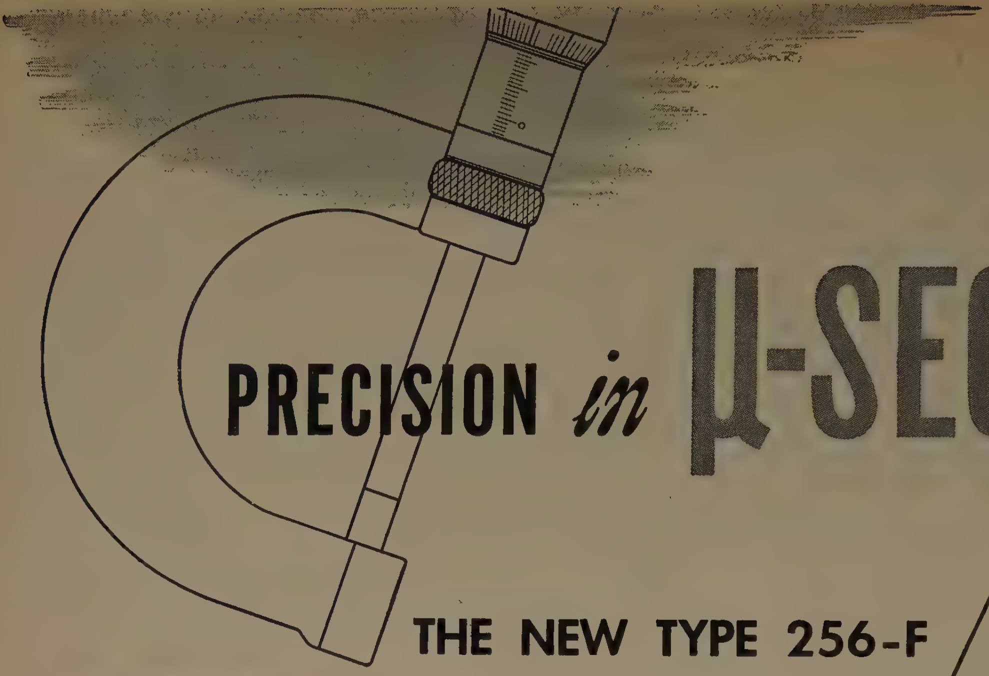
Midland Crystals measure up to Collins' strict standards because every one of the millions of Midland Crystals in use today is a product of Midland Quality Control. This is the system by which every crystal is constantly checked and tested at every step in processing. Midland employs the highest technical skill and finest production facilities known to the industry. It is your assurance of completely dependable crystal performance.



Whatever your Crystal need, conventional or specialized
When it has to be exactly right, contact

Midland MANUFACTURING COMPANY, INC.
3155 Fiberglas Road • Kansas City, Kansas

WORLD'S LARGEST PRODUCER OF QUARTZ CRYSTALS



PRECISION *in* μ-SECS

THE NEW TYPE 256-F

and for PRECISION IN YARDS

THE NEW TYPE 256-G

GREATER SENSITIVITY, GREATER UNDISTORTED DEFLECTION

The new Types 256-F and 256-G are similar in every way to their predecessors, the Types 256-D and 256-E, respectively, except that these new instruments employ the high-sensitivity Type 5YP- Cathode-ray Tube, providing an increase by a factor of approximately 2 in vertical-deflection sensitivity and undistorted deflection.

The new Type 256-F is a high-precision time-measuring device designed for general-purpose functions in laboratory work.

The calibrated sweep delay of the Type 256-F will measure time intervals up to 1000 microseconds with an accuracy of ±0.1% of the full-scale ranges of 100 μ-secs. or 1000 μ-secs. A movable marker indicates the portion of the sweep which is expanded on shorter, delayed sweeps. Delayed sweeps are of 4-, 10-, and 25-microsecond durations. Undelayed sweeps are available in six ranges from 4- to 4500-microseconds.

Response of the video amplifier is within ±1 db at 20 cps; down less than 3 db at 8 mc, no more than 6 db at 11 mc. Sensitivity is 0.31 peak-to-peak volt per inch. Pulse response is such that a rise time of 0.01 microsecond will be reproduced as a rise time of 0.04 microsecond or less.

Crystal-controlled timing markers calibrate the delay circuits. Delayed and undelayed sweeps may be started by external trigger pulses of either polarity or by built-in trigger generator providing 1-microsecond pulses of either polarity, having a rise time of 0.3 microsecond and amplitude greater than 100 volts. Trigger repetition rates up to 2000 P.P.S. are available.

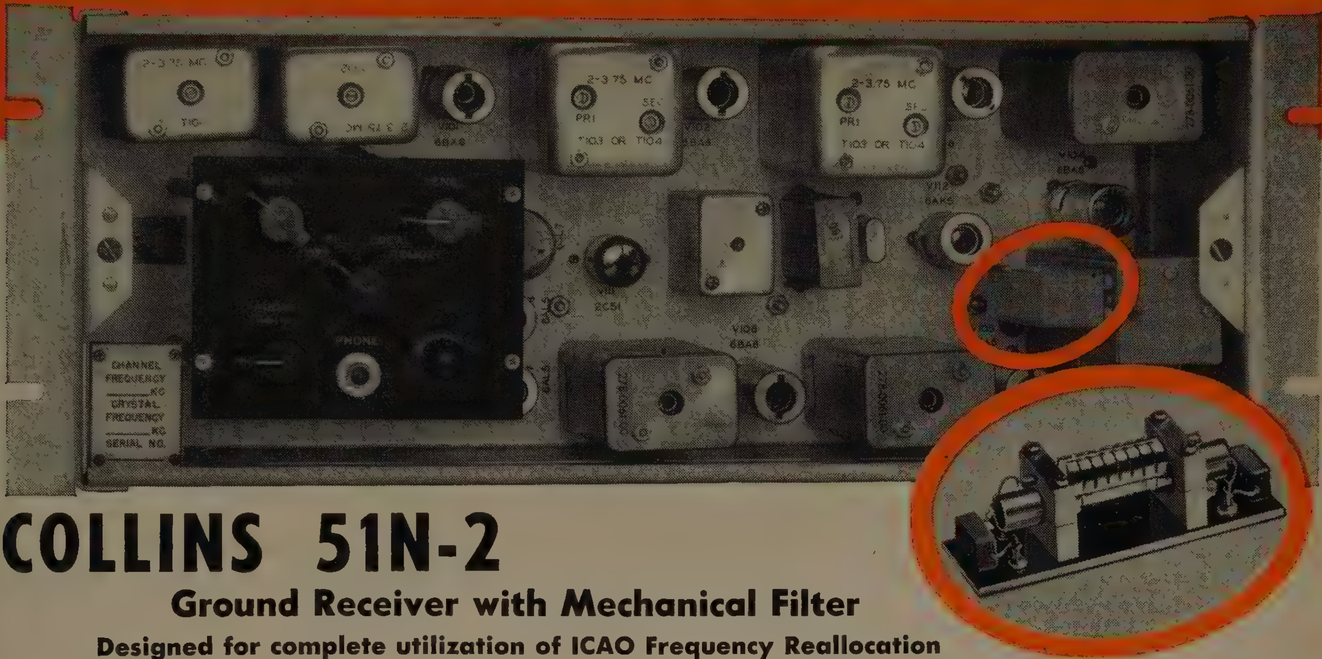
The new Type 256-G is electrically similar to the Type 256-F, except that the Type 256-G is calibrated in yards instead of microseconds. The Type 256-G is designed especially as test equipment for electronic ranging systems, or as a precision accessory unit for radar systems. It provides undelayed sweeps of 800, 2000, 4000, 20,000 and 200,000 yards in addition to a 4500-microsecond sweep. Delayed sweeps of 800, 2000 and 4000 yards may also be selected.

PRICE:
$1710.00

DU MONT
for Oscillography

Technical Sales Department, **ALLEN B. DU MONT LABORATORIES, Inc.**, 760 Bloomfield Ave., Clifton, N. J.

PREMIUM SELECTIVITY



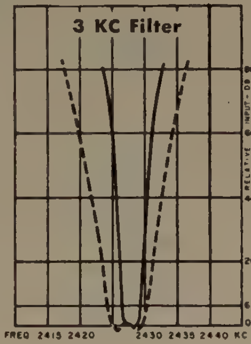
COLLINS 51N-2

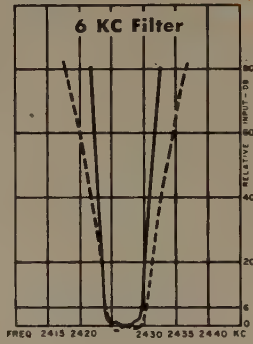
Ground Receiver with Mechanical Filter

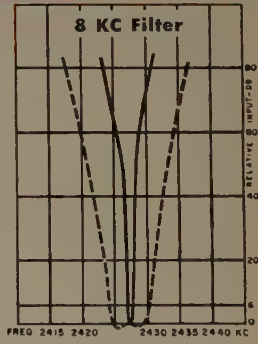
Designed for complete utilization of ICAO Frequency Reallocation

OPERATING CONDITIONS

- ★ −20° C to +55° C ambient temperature range.
- ★ Up to 10,000 ft. elevation.
- ★ 115 Volts 50-60 cps power source.
- ★ Service range 105-130 volts.







━━━━ **Selectivity Curve with Mechanical Filter**

▬ ▬ ▬ ▬ **Standard Selectivity Curve**

The Collins 51N-2 Receiver is thoroughly engineered for continuous, unattended airline duty plus other applications calling for A1, A2 and A3 reception at any one frequency within the range of 2 to 24 mc.

Reliability is fully assured through straightforward design and conservative operation of select quality components.

Premium selectivity is fully assured through the use of Collins' new mechanical filter (see selectivity curves above). The increased selectivity afforded by the mechanical filter greatly improves signal strength and clarity. This is another example of the many applications of the filter in improving radio communications . . . another example of Collins advanced engineering and design assisting the maintenance of consistent and reliable communications, point-to-point, air-to-ground the world over.

Choose selectivity characteristics to suit your communications requirements. Graphs show selectivity curves of 51N-2 before and after inclusion of Mechanical Filters.

MODIFICATION KITS AVAILABLE

You can modernize your present communication facilities with Collins Mechanical Filter Modification Kits. Compact, permanently tuned band pass filters for intermediate frequency applications, Collins Mechanical Filters fill a long felt need in the electronics field.

Write for complete details.

For advanced electronic communications, it's . . .

COLLINS

COLLINS RADIO COMPANY, Cedar Rapids, Iowa

11 W. 42nd St., NEW YORK 36
1930 Hi-Line Drive, DALLAS 2
2700 W. Olive Ave., BURBANK

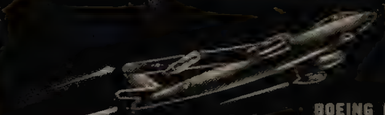
Filtered by Filtron

LOCKHEED F-94

GUARANTEES CONFORMANCE TO RADIO INTERFERENCE SPECIFICATION

MIL-I-6181

(0.15 TO 1000 MEGACYCLES)



BOEING B-47

Filters by Filtron

FILTRON'S Engineering division, with its completely equipped screen room facilities, is always available to measure and recommend RF Interference Filters for your equipment, to meet and exceed the Radio Interference requirements of MIL-I-6181.

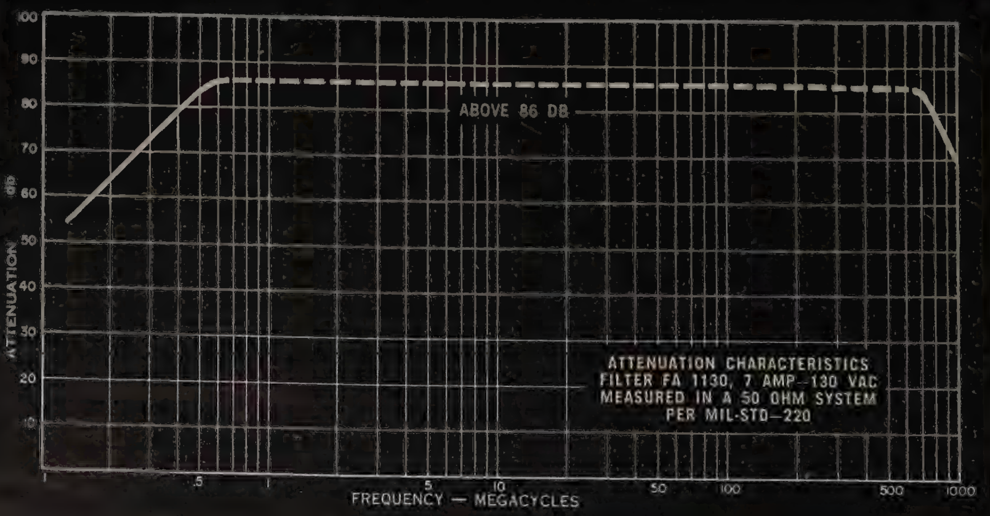
FILTRON'S production facilities are suppying more RF Interference Filters for use in military electronic equipment than ever before, to meet the nation's requirements.

FILTRON . . . the LEADER IN RF INTERFERENCE FILTERS . . . has pioneered:

- Sub-miniature Filters
- High-temperature Filters
- RF Filters to withstand Shock and Vibration
- Wide band Multi-section Units
- RF Filters "Custom Designed" to meet YOUR requirements

FILTER FA 1130
7 AMP - 130 VAC/500 VDC, 0-1700~
2" x 2" x 1⅛" DEEP
BULKHEAD MOUNTED

THE 1130 SERIES IS AVAILABLE UP TO 20 AMPERES, 130 VAC/500 VDC, 0-1700~ IN STANDARD OR BULKHEAD MOUNTING, WITH SCREW OR SOLDER TYPE TERMINALS. UNITS ARE HERMETICALLY SEALED AND ARE AVAILABLE FOR 85°C OR 125°C OPERATION. THESE FILTERS HAVE MINIMUM VOLTAGE DROP, AND MEET MILITARY REQUIREMENTS.



ATTENUATION CHARACTERISTICS
FILTER FA 1130, 7 AMP—130 VAC
MEASURED IN A 50 OHM SYSTEM
PER MIL-STD—220

An inquiry on your Company letterhead will receive prompt attention

THE FILTRON COMPANY INC., FLUSHING, LONG ISLAND, NEW YORK

LARGEST EXCLUSIVE MANUFACTURERS OF RF INTERFER

when to use Hermetic's New Vac-tite* Compression Seals

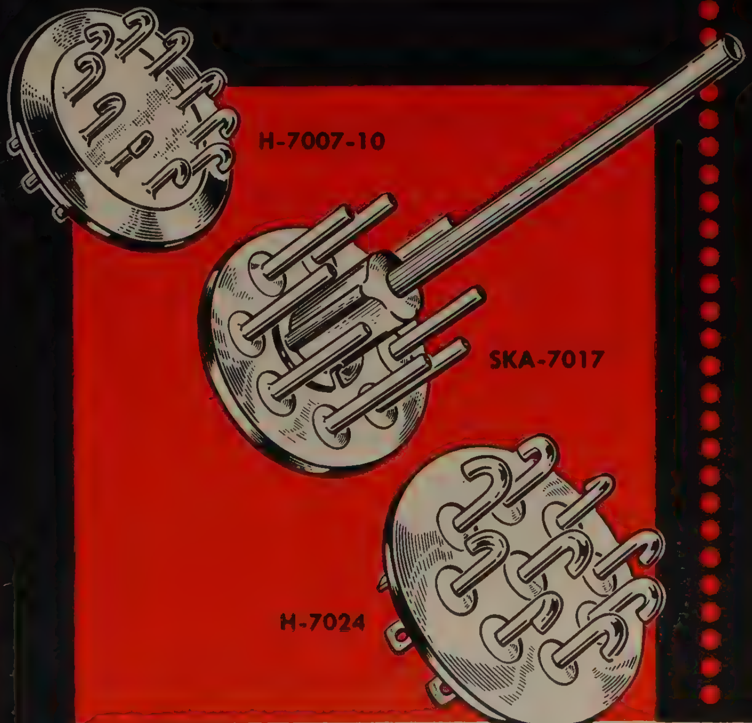
and why...

when vacuum tightness is a requisite, HERMETIC's proven compression seals are guaranteed to be vacuum tight, as evidenced by Mass Spectrometer Test.

when a RUGGED seal is required for application under adverse design conditions, the massive compression construction resists destructive deflection and permits direct mounting of components on the metal body.

The following styles of proven VAC-TITE compression seals are available:

1. Individual terminals and feed-throughs with a full range of hooked, flattened and pierced, turret and lug-type terminations for every application.
2. All-glass construction multi-terminal headers featuring larger leakage paths and an absence of moisture pockets.
3. Individually glassed plates available in a multiplicity of standard designs and easily adaptable to special designs in a variety of shapes and sizes for every requirement.
4. Plugs for standard sockets in several mounting types . . . such as octal, 7-pin miniature, noval as well as rectangular shapes.



Write for complete information on how HERMETIC engineers can apply "All-Glass" Compression Seals to your regular or special applications. Available, too, is HERMETIC's Brochure CS on Compression Seals, as well as a 32-page catalog on its standard line.

*VAC-TITE is HERMETIC's new vacuum proof compression-construction glass to metal seal.

SEALED IN by HERMETIC HEADERS

HERMETIC SEAL PRODUCTS CO.,

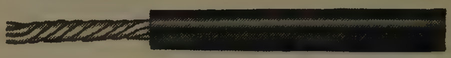
29 South Sixth Street
Newark 7, New Jersey

LENZ

electronic wire and cables for standard and special applications

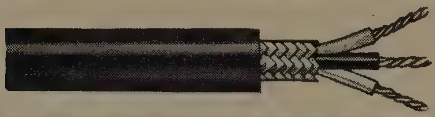
Whether your particular requirements are for standard or special application, choose *LENZ* for the *finest* in precision-manufactured electronic wire and cable.

GOVERNMENT PURPOSE RADIO AND INSTRUMENT HOOK-UP WIRE,
plastic or braided type, conforming to Government Specification JAN-C-76, etc., for radio and instruments. Solid or flexible conductors, in a variety of sizes and colors.



SPECIAL HARNESSES,
cords and cables, conforming to Government and civilian requirements.

RADIO AND INSTRUMENT HOOK-UP WIRE,
Underwriters Approved, for 80° C., 90° C. and 105° C. temperature requirements. Plastic insulated, with or without braids.

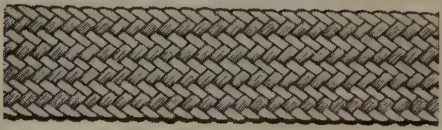


SHIELDED JACKETED MICROPHONE CABLE
Conductors: Multiple—2 to 7 or more conductors of stranded tinned copper. Insulation: extruded color-coded plastic. Closely braided tinned copper shield. Tough, durable jacket overall.

RF CIRCUIT HOOK-UP AND LEAD WIRE
for VHF and UHF, AM, FM and TV high frequency circuits. LENZ Low-Loss RF wire, solid or stranded tinned copper conductors, braided, with color-coded insulation, waxed impregnation.

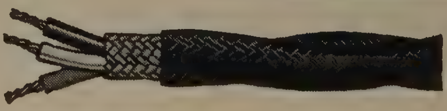
JACKETED MICROPHONE CABLE
Conductors: Extra-flexible tinned copper. Polythene insulation. Shield: #36 tinned copper, closely braided, with tough durable jacket overall. Capacity per foot: 29MMF.

SHIELDED MULTIPLE CONDUCTOR CABLES
Conductors: Multiple—2 to 7 or more of flexible tinned copper. Insulation: extruded color-coded plastic. Closely braided tinned copper shield. For: Auto radio, indoor PA systems and sound recording equipment.



TINNED COPPER SHIELDING AND BONDING BRAIDS
Construction: #34 tinned copper braid, flattened to various widths. Bonding Braids conforming to Federal Spec. QQ-B-575 or Air Force Spec. 94-40229.

SHIELDED COTTON BRAIDED CABLES
Conductors: Multiple—2 to 7 or more of flexible tinned copper. Insulation: extruded color-coded plastic. Cable concentrically formed. Closely braided tinned copper shield plus brown overall cotton braid.



PA AND INTERCOMMUNICATION CABLE
Conductors: #22 stranded tinned copper. Insulation: textile or plastic insulated conductors. Cable formed of Twisted Pairs, color-coded. Cotton braid or plastic jacket overall. Furnished in 2, 5, 7, 13 and 25 paired, or to specific requirements.

CHECK LENZ FIRST!

Lenz Electric Manufacturing Co.
1751 N. Western Ave., Chicago 47, Illinois
Our 48th Year in Business

cords, cable and wire for radio ◆ p. a. ◆ test instruments ◆ component parts

making "SPECIALS"* out of STANDARDS...

at SPECIAL CONTROLS HEADQUARTERS

*There isn't the price differential you'd expect between Clarostat *standard* controls and those *special* controls you need.

Using established designs, elements and production facilities for standard controls made by the tens of thousands, Clarostat engineers can come up with ingenious modifications at *marked savings to you.*

Note the standard 1⅛″ carbon control that became a dual-concentric with locked semi-permanent settings. Or the 15/16″ standard which, with rubber gaskets, meets water-tight requirements.

Making "specials" out of "standards" is all in the day's work at Clarostat, when you're *economy-minded.*

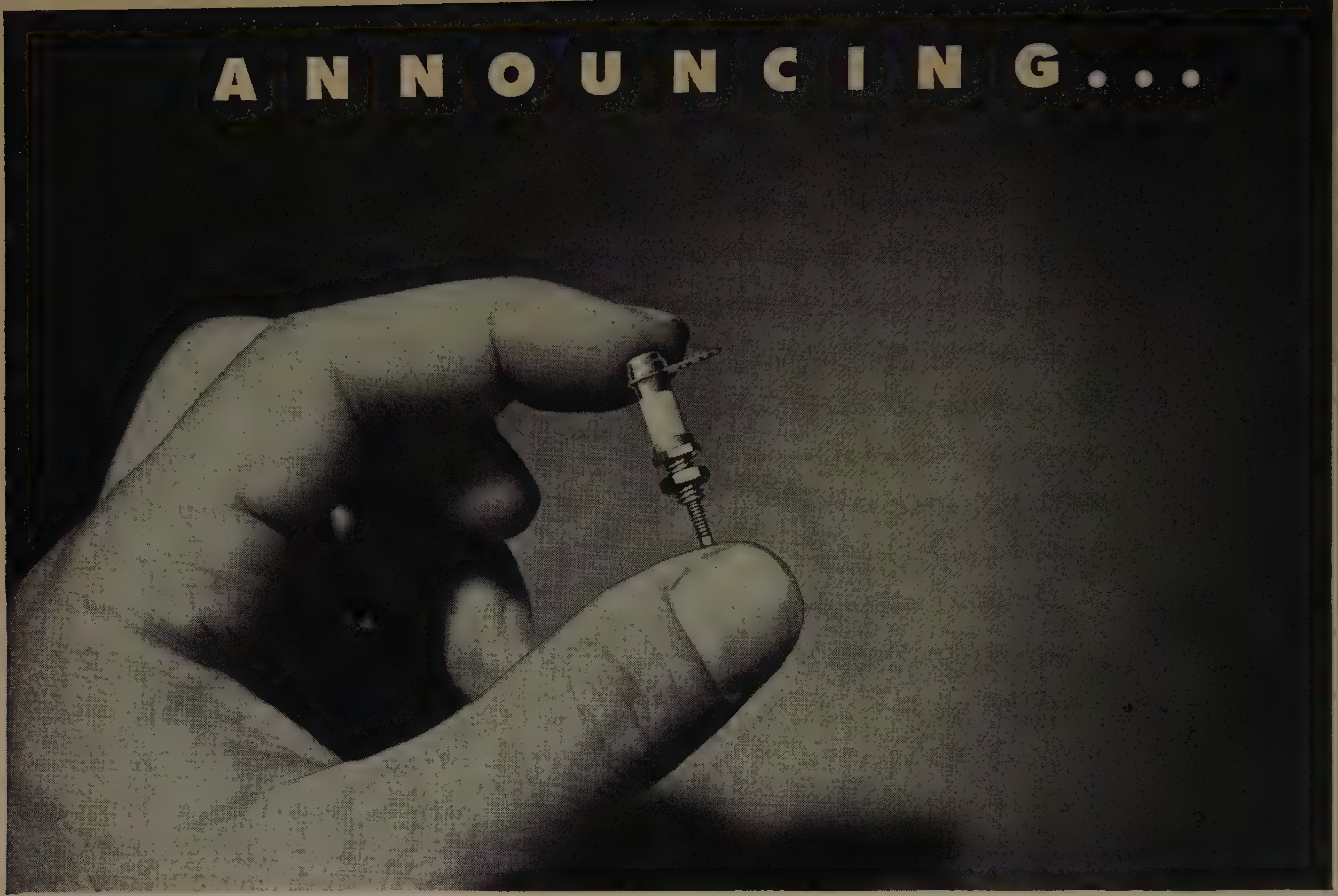
STAND PAT WITH

Send us those "special" control requirements for the most economical solution. Engineering data, quotations, delivery schedules, on request.

CLAROSTAT Controls and Resistors

CLAROSTAT MFG. CO., INC., DOVER, NEW HAMPSHIRE
In Canada: Canadian Marconi Co., Ltd., Toronto, Ontario

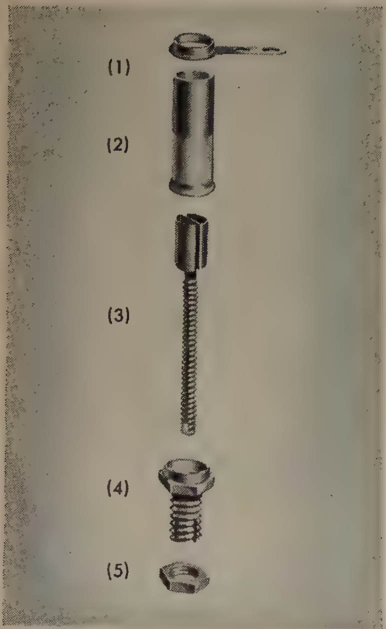
ANNOUNCING...



Shown approximately full size.

C.T.C.'s new CST-50 capacitor

with greatly increased range, greater stability



Exploded view of the CST-50 capacitor shows: (1) ring terminal with two soldering spaces; (2) metallized ceramic form; (3) spring-type S-shaped tuning sleeve*; (4) split mounting stud; (5) locking nut.

Surpasses the range of capacitors many times larger in physical size.

The new CST-50 variable ceramic capacitor embodies a tunable* element of such unusual design it practically eliminates losses due to air dielectric. As a result, a large minimum to maximum capacity range (1.5 to 12 MMFD) is realized — despite the small physical size of the capacitor. This tunable* element is a spring-type, S-shaped tuning sleeve* which maintains constant maximum pressure against the inside wall of the ceramic form.

Other Design Features

The CST-50 stands only 19/32″ high when mounted, is less than ¼″ in diameter and has an 8-32 threaded mounting stud. The mounting stud is split so that the tuning sleeve* can be securely locked without causing an unwanted change in capacity. The tuning sleeve* is at ground potential. The CST-50 is provided with a ring terminal which has two soldering spaces.

All C.T.C. materials, methods and processes meet applicable government specifications. For further information on C.T.C. components and C.T.C.'s consulting service (available without extra charge) write us direct. Cambridge Thermionic Corporation, 456 Concord Avenue, Cambridge 38, Mass. West Coast manufacturers contact: E. V. Roberts, 5068 West Washington Blvd., Los Angeles and 988 Market St., San Francisco, California.

CAMBRIDGE THERMIONIC CORPORATION

custom or standard . . . the guaranteed components

Write for Free Catalog #400 containing complete data on the entire CTC line.

* Patent Applied For

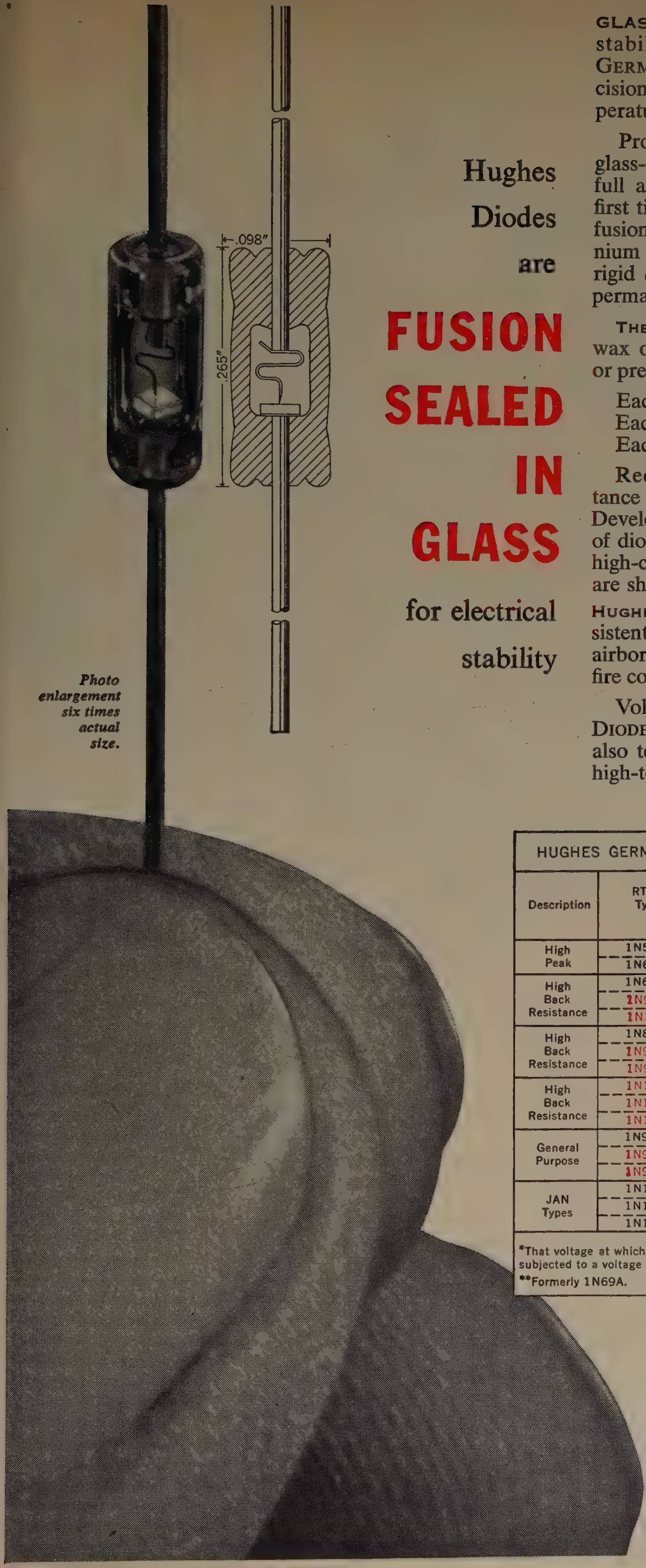


Photo enlargement six times actual size.

Hughes Diodes are FUSION SEALED IN GLASS for electrical stability

GLASS-TO-METAL fusion sealing for electrical stability is an exclusive feature of **HUGHES GERMANIUM DIODES**. The final seal in precision assembly operations is made at a temperature exceeding 700° C.

Proved in billions of vacuum tubes, the glass-to-metal seal has been incorporated to full advantage in diode manufacture for the first time by the Hughes-developed process of fusion sealing. The result is a unique germanium diode whose elements are encased in a rigid *one-piece* glass envelope, which assures permanent freedom from moisture penetration.

THE HUGHES GERMANIUM DIODE employs no wax or solder, and has no mechanical joints or pressed-in parts to shift position.

Each **HUGHES DIODE** is humidity-cycled.
Each **HUGHES DIODE** is temperature-cycled.
Each **HUGHES DIODE** is JAN shock-tested.

Recently announced new High-Conductance diodes, created by Hughes Research and Development Laboratories, set new standards of diode conductance. Characteristics of these high-conductance diode types, indicated in red, are shown in the table below.

HUGHES GERMANIUM DIODES have proved consistently able to meet exacting requirements in airborne electronic equipment for navigation, fire control and guided missiles.

Volume orders for most types of **HUGHES DIODES** can be filled from stock. Diodes are also tested to special specifications, including high-temperature electrical requirements.

HUGHES GERMANIUM DIODE ELECTRICAL SPECIFICATIONS AT 25° C.

Description	RTMA Type	Test Peak Inverse Voltage* (volts)	Maximum Inverse Working Voltage (volts)	Minimum Forward Current @ +1 v (ma)	Maximum Inverse Current (ma)
High Peak	1N55B	190	150	5.0	0.500 @ −150 v
	1N68A	130	100	3.0	0.625 @ −100 v
High Back Resistance	1N67A	100	80	4.0	0.005 @ −5 v; 0.050 @ −50 v
	1N99	100	80	10.0	0.005 @ −5 v; 0.050 @ −50 v
	1N100	100	80	20.0	0.005 @ −5 v; 0.050 @ −50 v
High Back Resistance	1N89	100	80	3.5	0.008 @ −5 v; 0.100 @ −50 v
	1N97	100	80	10.0	0.008 @ −5 v; 0.100 @ −50 v
	1N98	100	80	20.0	0.008 @ −5 v; 0.100 @ −50 v
High Back Resistance	1N116	75	60	5.0	0.100 @ −50 v
	1N117	75	60	10.0	0.100 @ −50 v
	1N118	75	60	20.0	0.100 @ −50 v
General Purpose	1N90	75	60	5.0	0.800 @ −50 v
	1N95	75	60	10.0	0.800 @ −50 v
	1N96	75	60	20.0	0.800 @ −50 v
JAN Types	1N126**	75	60	5.0	0.050 @ −10 v; 0.850 @ −50 v
	1N127†	125	100	3.0	0.025 @ −10 v; 0.300 @ −50 v
	1N128‡	50	40	3.0	0.010 @ −10 v

*That voltage at which dynamic resistance is zero under specified conditions. Each Hughes Diode is subjected to a voltage rising linearly at 90 volts per second.

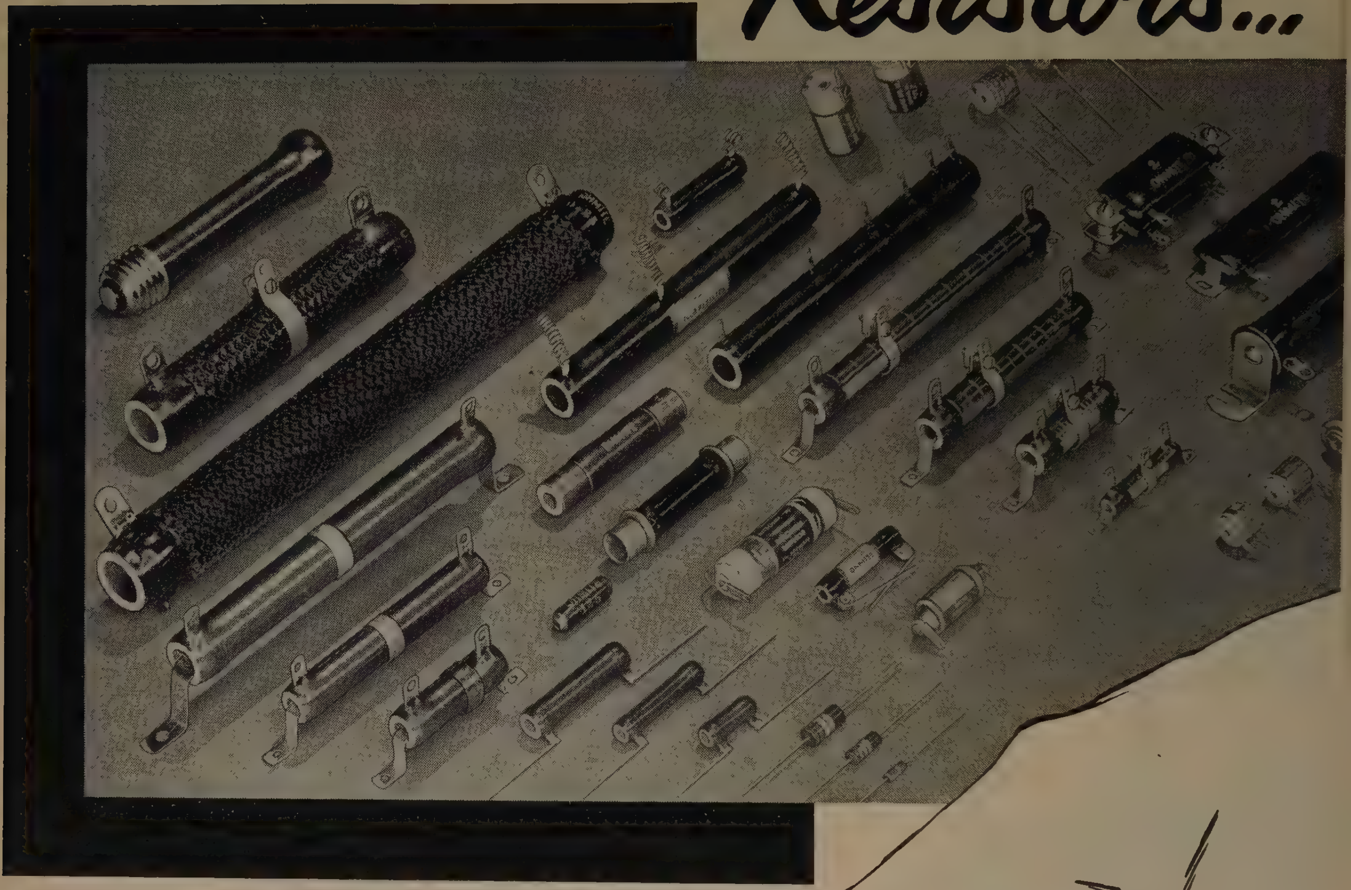
**Formerly 1N69A. †Formerly 1N70A. ‡Formerly 1N81A. New types in red.

Semiconductor
Sales Department
Hughes
AIRCRAFT COMPANY
CULVER CITY
CALIFORNIA

Address inquiries to Dept. PR

OHMITE®

Resistors...



THE MOST COMPLETE LINE OF WIRE-WOUND RESISTORS ON THE MARKET

Whatever your resistor needs . . . chances are there's an Ohmite resistor "tailored" exactly to the job. For the Ohmite line includes literally hundreds of units covering a wide range of types and sizes. There are fixed, tapped, adjustable, precision, and non-inductive resistors, with many types of terminals and mountings in a variety of ratings. Regardless of the particular unit *you* need, you are assured of the special design and construction features that have earned Ohmite's reputation for unsurpassed dependability.

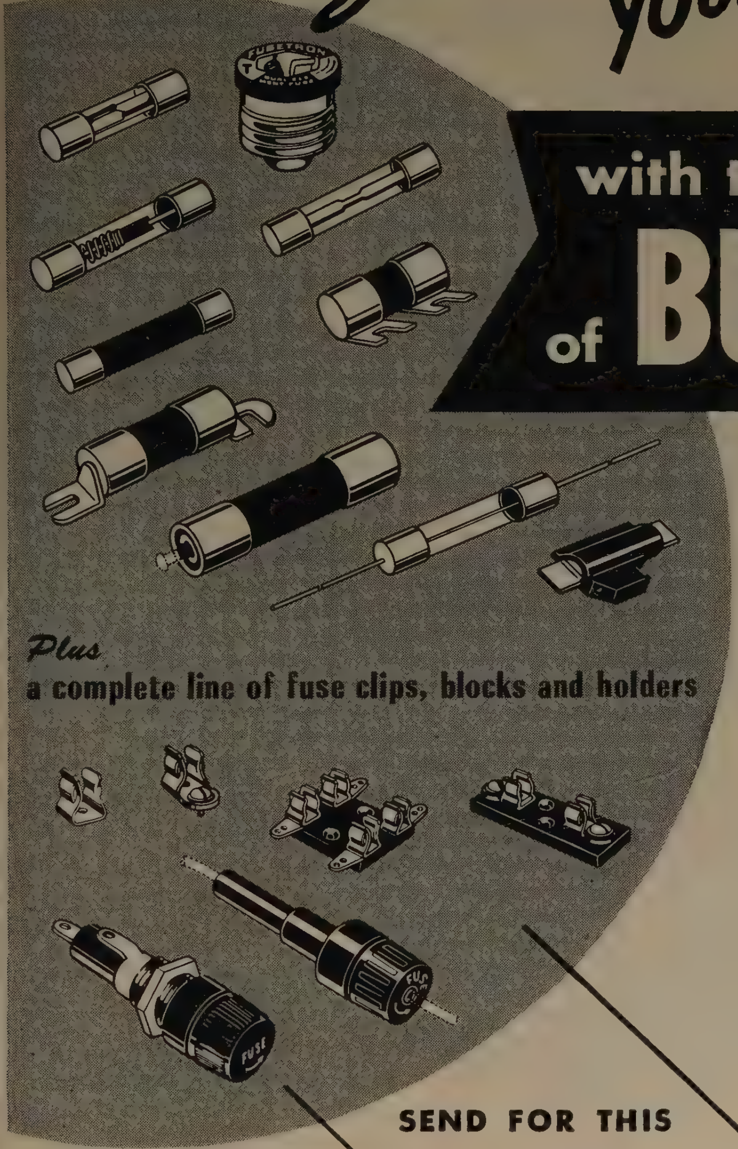
OHMITE®

Write on Company Letterhead
for Catalog No. 40
Ohmite Manufacturing Co.
4862 Flournoy Street
Chicago 44, Illinois

FIRST IN WIRE-WOUND RHEOSTATS AND RESISTORS

Save by Standardizing YOUR ELECTRICAL PROTECTION

with the Complete Line of BUSS FUSES



Plus
a complete line of fuse clips, blocks and holders

for Television · Radio · Radar · Instruments · Controls · Avionics

You'll save time and trouble when all your fuse needs are supplied by one, dependable source. The complete BUSS line makes it easy for you to select the fuse to do the job right.

Behind every BUSS fuse is the world's largest fuse research laboratory and fuse production capacity. To assure and maintain top quality, each individual BUSS fuse is tested in a highly sensitive electronic device. Any fuse that is not correctly calibrated, properly soldered or the right dimensions, is automatically rejected.

Start now to simplify your fuse selection and save by standardizing on the complete BUSS line.

SEND FOR THIS HELPFUL INFORMATION

DO YOU HAVE A PROTECTION PROBLEM?

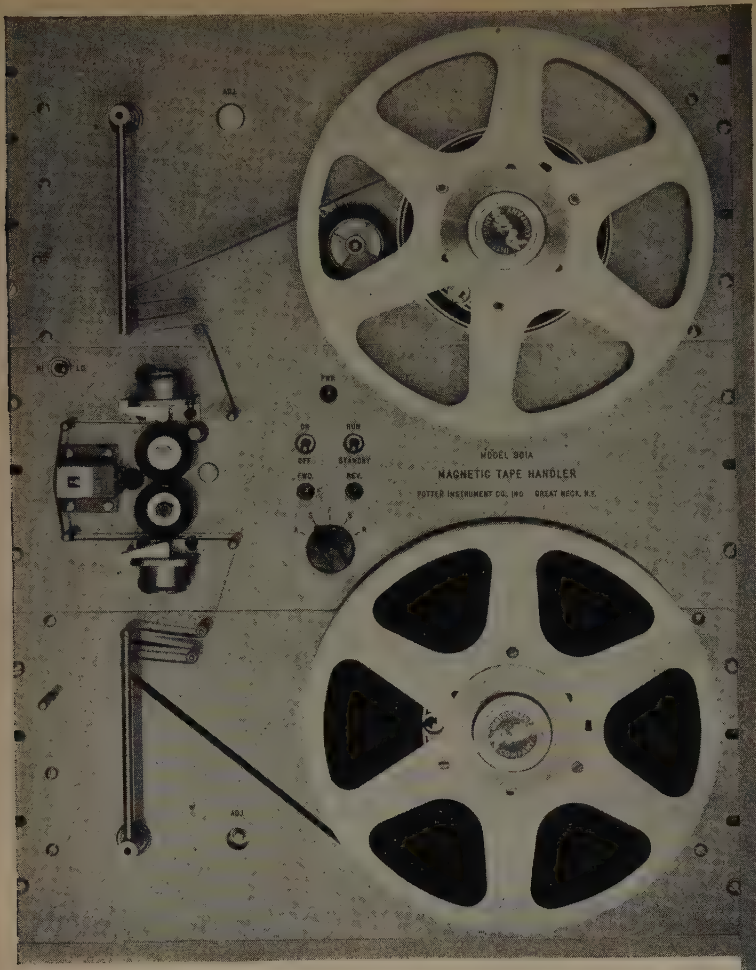
BUSS fuse engineers are at your service. They will be glad to help you select the fuse that will do the job best... if possible, a fuse that is available from local wholesalers' stocks.

BUSSMANN Mfg. CO., Division of McGraw Electric Co
University at Jefferson, St. Louis 7, Missouri

BUSSMANN Mfg. Co. (Division of McGraw Electric Co.)
University at Jefferson, St. Louis 7, Mo.

Please send me bulletin SFB containing facts on BUSS small dimension fuses and fuse holders.

*Name*____________________
*Title*____________________
*Company*____________________
*Address*____________________
*City & Zone*__________ *State*________ IRE-653



Announcing THE Potter DIGITAL MAGNETIC-TAPE HANDLER

A PRECISION RECORDER AT A REASONABLE PRICE!

SPECIFY IT FOR:

START-STOP RECORDING
•
DATA REDUCTION
•
TELEMETERING
•
SORTING
•
COLLATING
•
LIST PROCESSING

SPECIFICATIONS

	Model 901A	Model 901B
Tape Width	½″	¼″
*No. of tracks	6	2
Reel Size	NAB Standard, 10½″	
Reel Capacity	2400 ft.	
Tape Speed	Dual-speed, 15 and 30 inches/sec.	
Start & Stop Time	5 millisecond, either direction.	
Control	Manual, or remote pulses, 15 volts positive.	

*Greater number of tracks available on special order.

ASSOCIATED DATA HANDLING COMPONENTS

Complete Data Handling Systems or individual plug-in components are available. Recording and playback amplifiers, electronic counters with transfer gates, shift registers, and other associated data reduction components can be supplied for special data handling problems.

Here is a new high-speed Magnetic Tape Handler for every data recording application. Exclusive features provide maximum versatility, complete dependability, ease of operation, and simplicity of maintenance, *and do it at a price thousands of dollars below anything now available.*

•

Unique in every respect, this outstanding Potter precision instrument provides 5 millisecond start and stop, forward or reverse, from external signals. Record, playback, or compare—every desirable function can be accomplished easily.

•

New photo-electric proportional servo tension controls assure uniform tape tension over the recording head at all speeds. Independent reel drives, controlled by the servos, assure freedom from tape breakage or spilling.

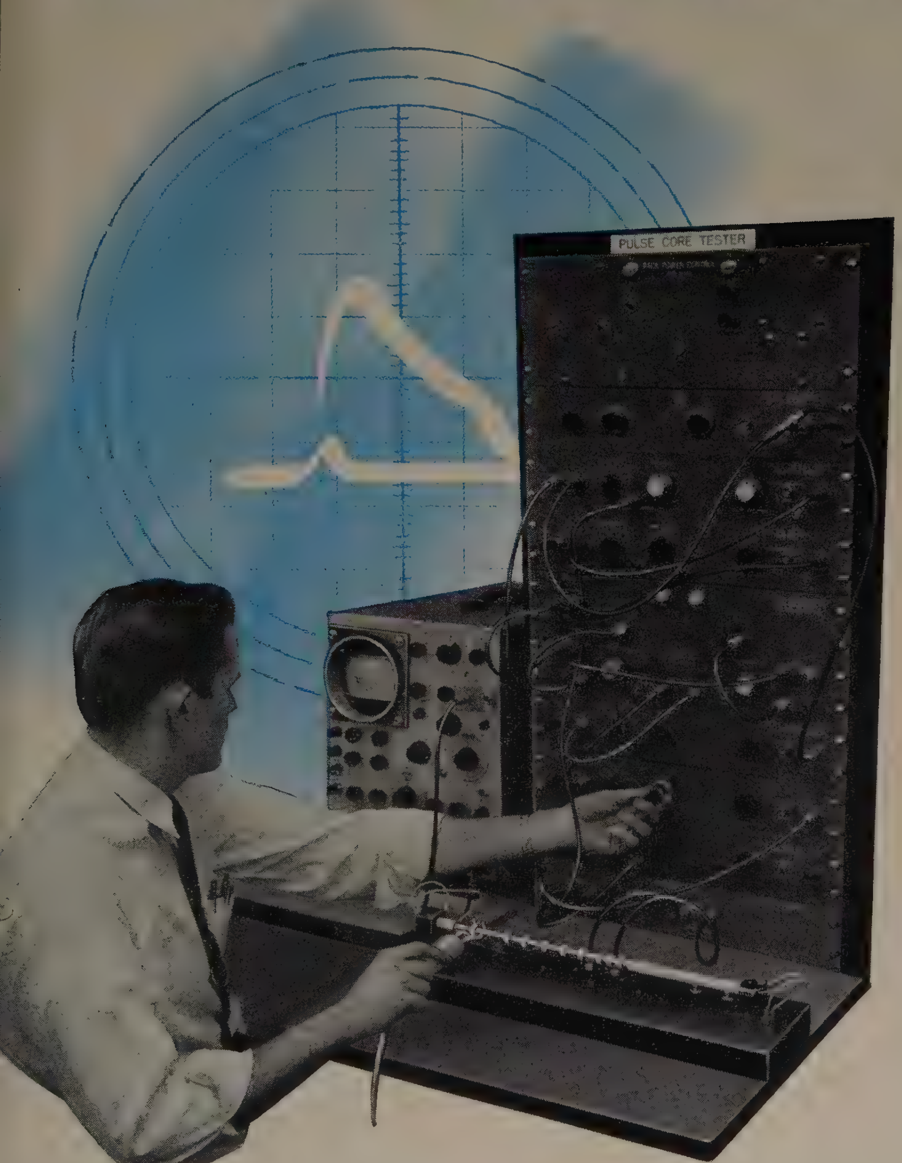
•

Do you have a problem in efficient *and economical* data handling? Check the performance specifications in the column at the left and, for complete information on how to fit the Potter Magnetic-Tape Handler into your program, **write, now, to Dept 6E.**

INSTRUMENT Potter COMPANY 107

POTTER INSTRUMENT COMPANY
INCORPORATED
115 CUTTER MILL ROAD, GREAT NECK, NEW YORK

"UNITIZED" PULSE CONTROL EQUIPMENT



Saves valuable research and testing time

Always in the past, it has been necessary to custom design pulse test equipment for each individual application—this has proved a most costly and time-consuming engineering operation. But now the major portion of this work can be eliminated through the use of Burroughs "Unitized" Pulse Control Equipment. These standardized units are complete within themselves and each performs one basic operation, such as generating, mixing, gating, counting, etc. The units can be arranged and rearranged in almost any manner necessary to simulate actual conditions of usage for the component part being tested.

AS AN EXAMPLE—MEASURING THE BEHAVIOR OF MAGNETIC CORES

FOR APPLICATIONS IN RADAR, TELEMETERING DIGITAL COMPUTING, TELEVISION AND NUCLEAR PHYSICS

Pictured here is a Burroughs Core Tester BCT-300 designed to swiftly and accurately measure the "switching time" and "squareness ratio" of toroidal cores. The unit is made up of eight standard Pulse Control units (one Low Frequency Pulse Generator 1004C, a Flip-Flop 1101C, a Coincidence Detector 1201B, and five Pulse Delay units 1301C) mounted in a rack with other accessory equipment. The output of this unit may be observed on a standard laboratory oscilloscope. Power is supplied from a 9101C power supply.

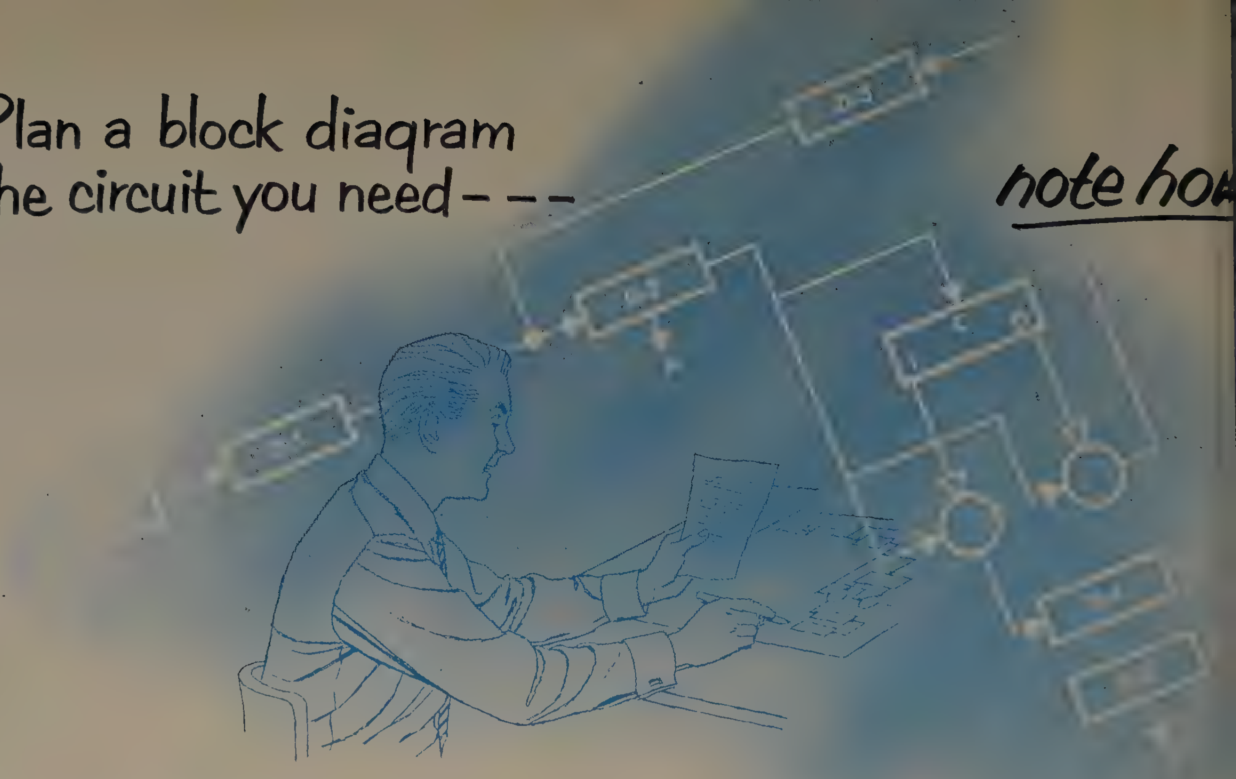
This BCT-300 is typical of the many possible applications of Burroughs "Unitized" Pulse Control Equipment. Pertinent characteristics and specifications of the individual units will be found on the following pages.

ELECTRONIC INSTRUMENTS DIVISION

Burroughs

Plan a block diagram of the circuit you need---

note ho



PULSE GENERATOR

Type 1004C — Generates 0.1 microsecond pulses at frequencies continuously variable from 15 to 650,000 cycles per second, in five overlapping bands. Output circuit is designed to match 93-ohm RG-62/U cable.

A symmetrical multivibrator is used to control the frequency. The output amplitude, which is not affected by changes in frequency, can be varied from 10 to 32 volts and the polarity of the output pulse is reversible.

Type 1002B — Generates 0.1 microsecond pulses (approx.) at frequencies continuously variable from 0.2 megacycles to 4.5 megacycles in four overlapping bands.

A calibrated, L-C controlled, sine-wave oscillator controls the frequency. The output amplitude, which is only affected by frequency changes in the ranges above 2 megacycles, can be varied from 10 to 32 volts and the polarity of the output pulse is reversible.

Type 1003A — This unit consists of three separate pulse generators mounted on a single panel, each section of which is capable of generating 0.1 microsecond pulses in three different ways.

1. Single pulse push-button operation.
2. The output pulse is generated by coincidence action of a push-button and a positive synchronizing pulse.
3. The output circuit acts as a pulse standardizing circuit when fed by external pulses. The output circuit is directly triggered by an input pulse with no push-button action.

Two inputs for each pulse generator are provided: one, "Synchronizing Input," for synchronization of push-button pulses; the other, "Low-frequency Input," for triggering the output circuit directly, without the use of the push-button. Positive pulses are available with output amplitudes adjustable from 0 to 35 volts.

PULSE GATER

Type 1501B — This unit comprises a gate generator with a manually adjustable gate length and an independent coincidence detector. The duration of a gating pulse is continuously adjustable from 0.3 microseconds to 5,000 microseconds in four overlapping ranges. The Pulse Gater replaces a Pulse Delay Unit, a Flip-Flop, and a Coincidence Detector for the purpose of generating pulse trains.

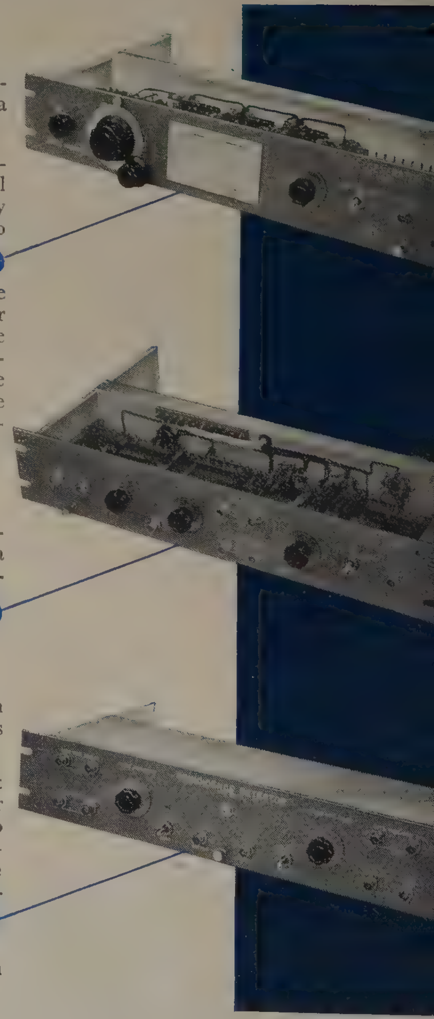
COINCIDENCE DETECTOR

Type 1201B — Two independent coincidence detectors are mounted on one panel. These units are designed to sense coincidence between the output signal of a flip-flop and 0.1 microsecond pulses. Two inputs are provided for each unit. Grid No. 1 is designed to accept 0.1 microsecond pulses with minimum amplitudes of 13 volts. Grid No. 3 is designed to accept the output of Type 1101C flip-flop or equivalent.

Type 1202A — Two separate coincidence detectors are mounted on one panel. Each is designed to sense coincidence between the output voltage levels of as many as five flip-flops.

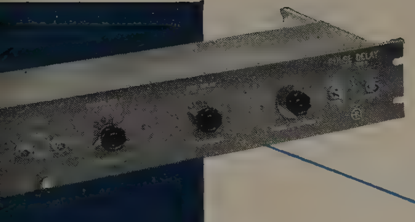
The principal difference between this unit and the Type 1201B coincidence detector is that the Type 1201B is designed to sense coincidence between a flip-flop output and 0.1 microsecond pulses, while the Type 1202A is designed to sense coincidence between output of one flip-flop and as many as four other flip-flops.

As many as six inputs may be driven in parallel from a single flip-flop output.



UNITIZED" PULSE CONTROL EQUIPMENT

shown here can be mounted on a 19-inch rack and arranged to fit your specific requirements



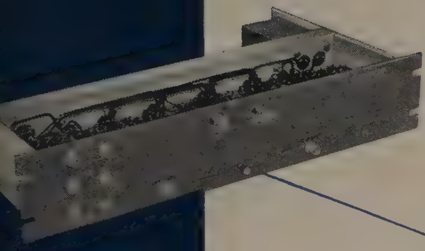
PULSE DELAY

Type 1301C — In this unit, a 0.1 microsecond input pulse triggers a single-shot multivibrator of controllable period, and a 0.1 microsecond pulse of reversible polarity is regenerated at the end of the multivibrator period. The delay of the 0.1 microsecond output pulse is continuously adjustable in five overlapping ranges from 1 microsecond to a maximum of about 80,000 microseconds.

In addition, a rectangular pulse with a duration equal to the delay period between the 0.1 microsecond input and output pulses is brought out to a jack on the front of the panel through a d-c coupled cathode follower so that it can be used for observing the time delay oscilloscopically.

Type 1302A — This unit delays 0.1 microsecond pulses by means of a tapped delay line in 0.05 microsecond steps from 0.1 to 1.9 microseconds. Reversible output polarity of variable amplitude is also provided.

Type 1303B — This unit, which provides a fixed delay of 0.1 microsecond is designed to be connected in cascade with RG-62/U coaxial cable without mismatch. Input and output cable connectors are mounted on a flanged box 4½ x 3 x 1¾ inches.

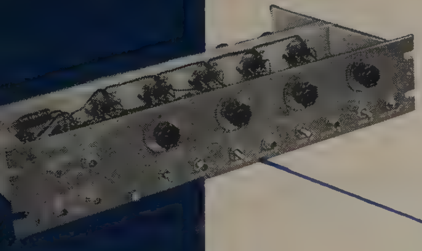


FLIP-FLOP

Type 1101C — The flip-flop is a bistable circuit designed specifically to provide an output voltage level to be used as a gate in coincidence circuits. The unit contains a pentode Eccles-Jordan circuit capable of being switched at rates up to 2.5 megacycles per second with 0.1 microsecond pulses.

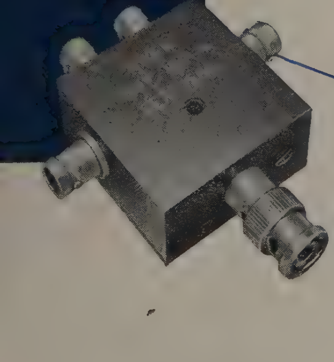
There are three inputs — zero, one, and complement—operating with minimum amplitudes of 12 volts. Two output jacks marked "Zero Gate" and "One Gate" supply either 0 volts or −23 volts at an impedence level of approximately 680 ohms.

There are two neon lights on the front of the panel which indicate the position of the flip-flop. There is also a terminal block on the rear of the unit which can be used to operate indicator lights installed at a remote point for visual monitoring.



GATED CHANNEL SELECTOR

Type 1402C — This unit is designed to sense coincidence between the output signal of a flip-flop and 0.1 microsecond pulses and to feed the output to four separate jacks. The input section is similar in action to that of coincidence detector, Type 1201B. Each of the output pulse positions has its own amplitude control and three-position toggle switch which is used to select pulse polarity or reject the output pulse. The ability of the unit to select any or all of the four output circuits in any combination permits the unit to be set up for a parallel binary code, where each output can be used to represent a single binary digit. The unit is also useful for feeding as many as four terminated lines from a single source.



MIXERS

Type 1601A—This mixer has four input positions which feed a common output through crystal diodes. Four standard input connectors and one output connector are mounted on a box 2½ x 2½ x 1 inch.

Type 1602A—This mixer is a panel-mounted twin mixer functionally equivalent to two of Type 1601A except with five input connectors and one output connector for each mixer.

ELECTRONIC INSTRUMENTS DIVISION

Burroughs

Burroughs Accessory
PULSE CONTROL EQUIPMENT
-necessary for fast circuit assembly

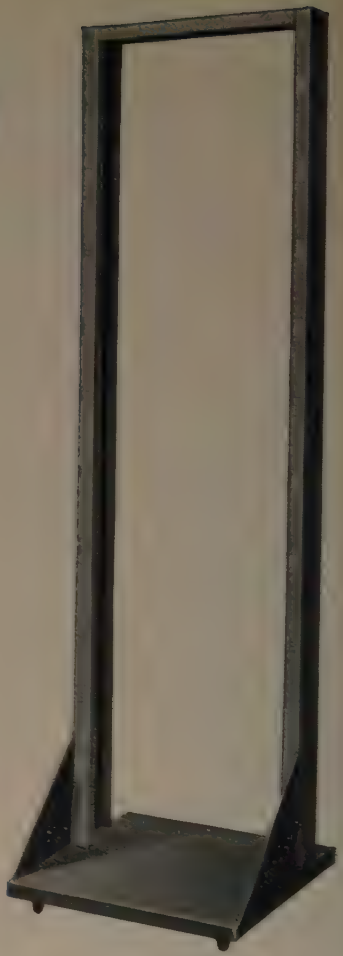
◀ POWER SUPPLY—Type 9101C

This unit is a magnetically regulated d-c power supply providing the seven voltages necessary for the operation of several pulse generators, flip-flops, coincidence detectors, etc. Each d-c voltage is automatically regulated to within ±1 per cent of the selected voltage for load variations from 10 per cent load to full load, and for a-c line input variations of ±8 per cent. Two separate transformers, each with tapped primaries and two secondaries, supply a total of 50 amperes of heater current at 6.3 volts.

The unit, which is operated from a 115-volt, 60-cycle, 20-ampere single-phase power source, has each of the seven output voltages interlocked by relays, thus providing protection from loss of voltage in any of the supplies, and has fuses for over-current protection.

MOUNTING RACK—Type 7002A ▶

This is a standard 19-inch relay rack with plug-in power outlets available along each side. Approximately 70 inches of mounting space are available. Overall dimensions of the swivel-caster unit are 73¼ x 20 x 21. It is finished to match the remaining units in the line.



A few current users of "Unitized" Pulse Control Equipment

Massachusetts Institute of Technology
University of Michigan
Consolidated Engineering Corporation
National Union Radio Corporation
The Catholic University of America
Stanford Research Institute
Magnetics Research Company

Originally created to speed up and simplify the building of electronic test equipment at the Burroughs Research Center, "Unitized" Pulse Control Equipment is now being used by many leading organizations in electronic research.

More than 500 of these pulse control panels were used in the construction of the high speed digital computer now in operation at the Burroughs Research Center. They represent the primary reason why it was possible to complete this unique machine in only nine months.

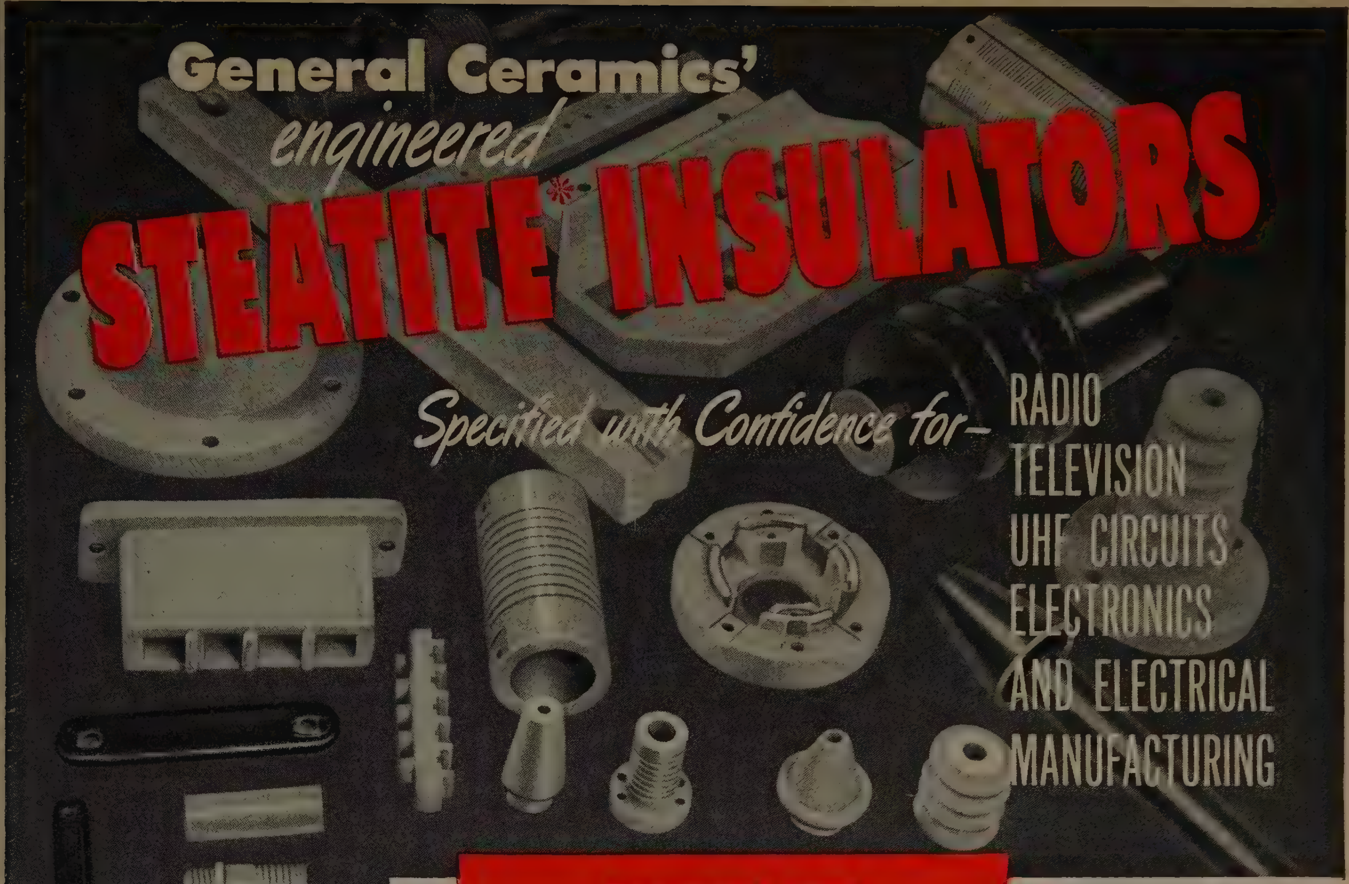
Incidentally, the services of the Burroughs computer are now available, on a fee basis, to interested organizations, both public and private. Typical computer users and their solved problems are: Westinghouse Aviation Gas Turbine Div. —*Turbojet engine design and performance calculations*. Philco — *Antenna calculations*. Bell and Howell — *Optical ray tracing*. Hydrocarbon Research, Inc.—*Stresses in pipe*. Roger Bellows & Associates—*Correlation of psychological tests on personnel.*

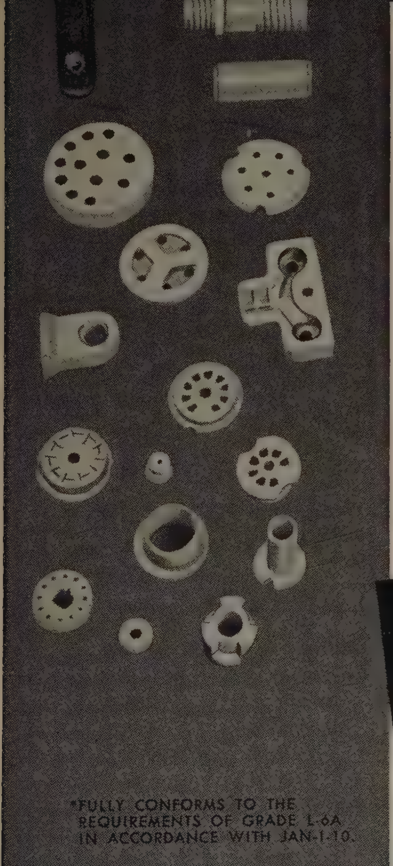
• • •

For full information and consultation regarding Burroughs "Unitized" Pulse Control Equipment, the Burroughs Digital Computer, or other problems related to electronics or magnetics, call or write Department 14, Electronic Instruments Division, Burroughs Research Center, 511 North Broad St., Philadelphia 23, Pa.

ELECTRONIC INSTRUMENTS DIVISIO

Burroughs





General Ceramics'

engineered

STEATITE* INSULATORS

Specified with Confidence for—
RADIO
TELEVISION
UHF CIRCUITS
ELECTRONICS
AND ELECTRICAL
MANUFACTURING

Pressed and Extruded Shapes to Close Tolerances

Engineered Steatite by General Ceramics offers the designer and engineer both excellent electrical and mechanical advantages and the economies of standard catalog body types. Offers low loss factor, zero moisture absorption, high surface and volume resistivity, high tensile and great compressive strength. Steatite insulators can be produced to countless sizes and shapes for practically all requirements.

Standard Shapes AVAILABLE:

- PILLAR INSULATORS
- LEAD-IN BUSHINGS
- ENTRANCE BUSHINGS
- COAXIAL CABLE INSULATORS
- LEAD-IN INSULATORS
- SPREADER INSULATORS
- STRAIN INSULATORS
- COIL FORMS
- SUPPORT BARS
- COUPLING INSULATORS

"STEATITE-BONDED-TO-METAL" COMBINATIONS

Steatite bonded to metal by the Solder-Seal method produces a permanent hermetic seal. Also recommended for re-inforcing steatite where exceptional mechanical strength is required.

FOR UHF CIRCUITS, SPECIAL G-C STEATITE

General Ceramics Special Steatite developed for UHF service. An engineered insulation with extremely low loss factor. Recommendations made on specific applications without obligation.

CUSTOM DESIGNS TO SPECIFICATION—

Special steatite insulators can be produced in any size or shape by pressing, extruding, casting or machining. Experienced engineers are available for consultation.

*FULLY CONFORMS TO THE REQUIREMENTS OF GRADE L-6A IN ACCORDANCE WITH JAN-I-10.

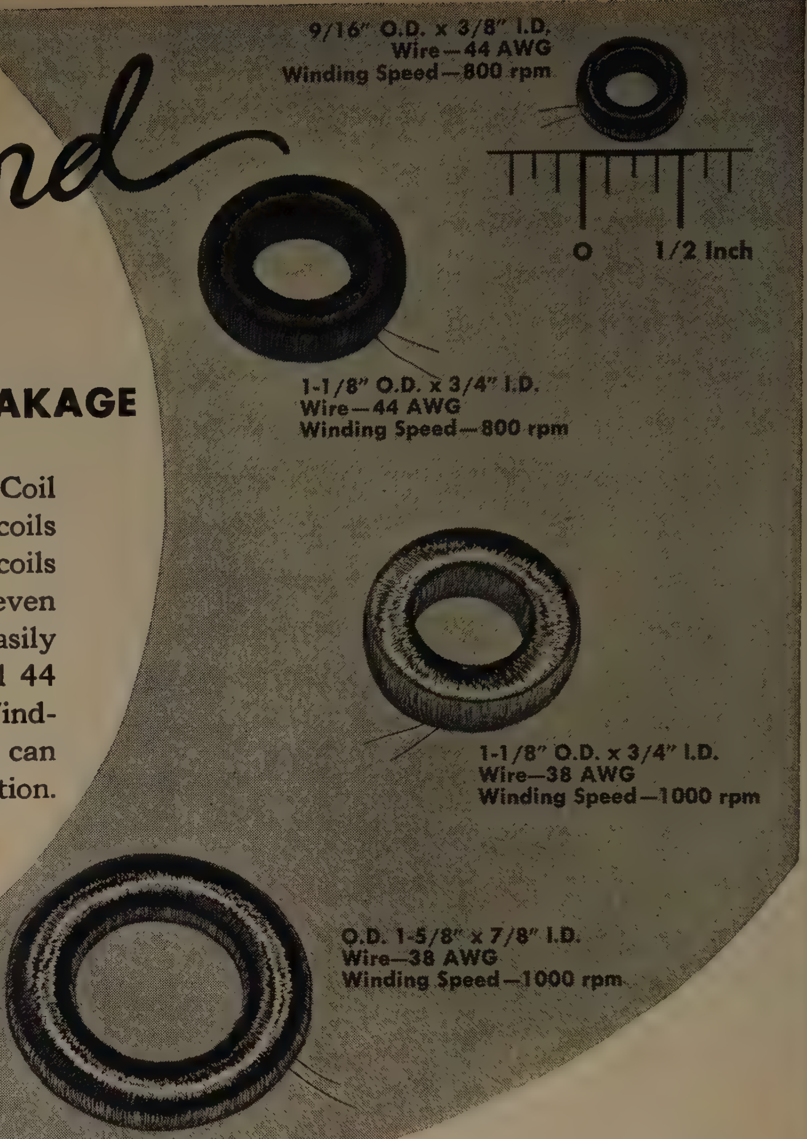
IF YOU HAVE A PROBLEM—

For complete information on General Ceramics Steatite Insulators, request the new illustrated catalog; for engineering assistance on specific problems, contact a General Ceramics Sales Engineer.

GENERAL CERAMICS and STEATITE CORP.
Perth Amboy 4-5100
GENERAL OFFICES and PLANT: KEASBEY, NEW JERSEY

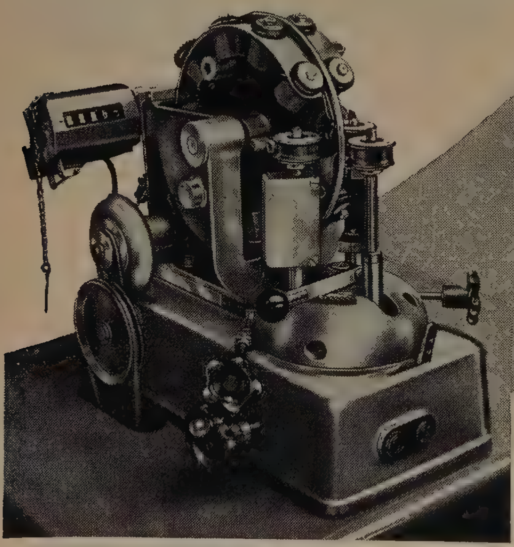
MAKERS OF STEATITE, TITANATES, ZIRCON PORCELAIN, FERRAMICS, LIGHT DUTY REFRACTORIES, CHEMICAL STONEWARE, IMPERVIOUS GRAPHITE AND FERRAMIC MAGNETIC CORES

EVENLY *Wind*



SMALL TOROIDAL COILS AT HIGH SPEEDS WITH MINIMUM WIRE BREAKAGE

The MICAFIL Model RW-0 Toroidal Coil Winder automatically winds toroidal coils continuously around 360° and sector coils from 30° to 270°. To produce smooth, even layers of wire, the winder is adjusted easily to wind any wire size between 26 and 44 AWG and to obtain the proper pitch. Winding direction can be changed and feeds can be adjusted while machine is in operation.



CAPACITY

Coil Sizes
  Minimum finished I.D. . . . . ¼"
  Maximum finished O.D. . . . . 2"
  Minimum finished O.D. . . . . ½"
Wire Sizes . . . . 26 to 44 AWG
Winding Speed—
  according to wire size. . up to 1000 rpm
Shuttle Capacity—
  according to wire size . . . 60 to 800 feet

MICAFIL Toroidal Coil Winders are made in three larger sizes for winding coils up to 8" O.D. and with 10 AWG Wire.

SPIRALING DEVICE—Device winds spirals for shuttle loads—in advance . . . Newly developed to permit continuous operation of Coil Winder . . . Winds to predetermined lengths.

SHUTTLES—Made in four different ring diameters to accommodate range of spiraled wire sizes . . . Larger wire capacities . . . *More than one coil can be wound with single loading* . . . Changed within 30 seconds . . . Loaded in less than a minute.

ACCURATE TURNS COUNTER—Preset for required number of turns . . . Automatically stops winder when turn count is reached.

Let Cosa Engineers study and recommend the winder for your needs. Or, write for Literature.

COSA CORPORATION
405 Lexington Ave., New York 17

Your source for all Precision Machine Tools—from Small Bench Lathes to Large Boring Mills

IN DETROIT AREA contact DETROIT-COSA CORPORATION, 16923 James Couzens Highway, Detroit 35, Mich.
IN CANADA contact COSA CORPORATION OF CANADA, LTD., 40 Front Street West, Toronto 1, Canada

ANNOUNCING

THE **AMPEX 350** TAPE RECORDER

- **A NEW MODEL** *by the leader in tape recording*

Ever since the first AMPEX (the Model 200) set a milestone in progress by making recorded sound "come to life," the broadcasting and recording industries have rightly expected new AMPEX models to set the pace.

- **A NEW SLANT** *on operating convenience*

With introduction of the AMPEX 350, a new 30° slant on the top plate puts the reels, editing knobs and all controls within easier reach of any operator — tall or short, standing or sitting. Tape editing is faster and less tedious. Servicing is simplified by pivoting of the top plate and sliding out of the internal assemblies.

- **A NEW STANDARD** *of reliability*

In precision of timing, response to controls and freedom from breakdowns and repairs, AMPEX Tape Recorders have consistently led the industry. For utmost reliability, this new Model 350 has a three motor tape transport mechanism (previously used in the AMPEX 300, but now available in this lower priced machine).

- **A NEW REASON** *to change to the best*

Ultra high fidelity recording is now priced within reach of discriminating users in every field — radio stations, home high fidelity systems, schools, industry and professional music. And because the AMPEX 350 is built to last, it will cost the least per hour, per week and per year.

AMPEX MODEL 350

Tape speeds — 7½ & 15 in/sec. or 3¾ & 7½ in/sec.

Frequency response

15 in/sec. — ± 2 db from 30 to 15,000 cycles
7½ in/sec. — ± 2 db from 30 to 10,000 cycles
± 4 db from 30 to 15,000 cycles
3¾ in/sec. — ± 2 db from 50 to 7,500 cycles

If you plan for tomorrow, buy AMPEX today

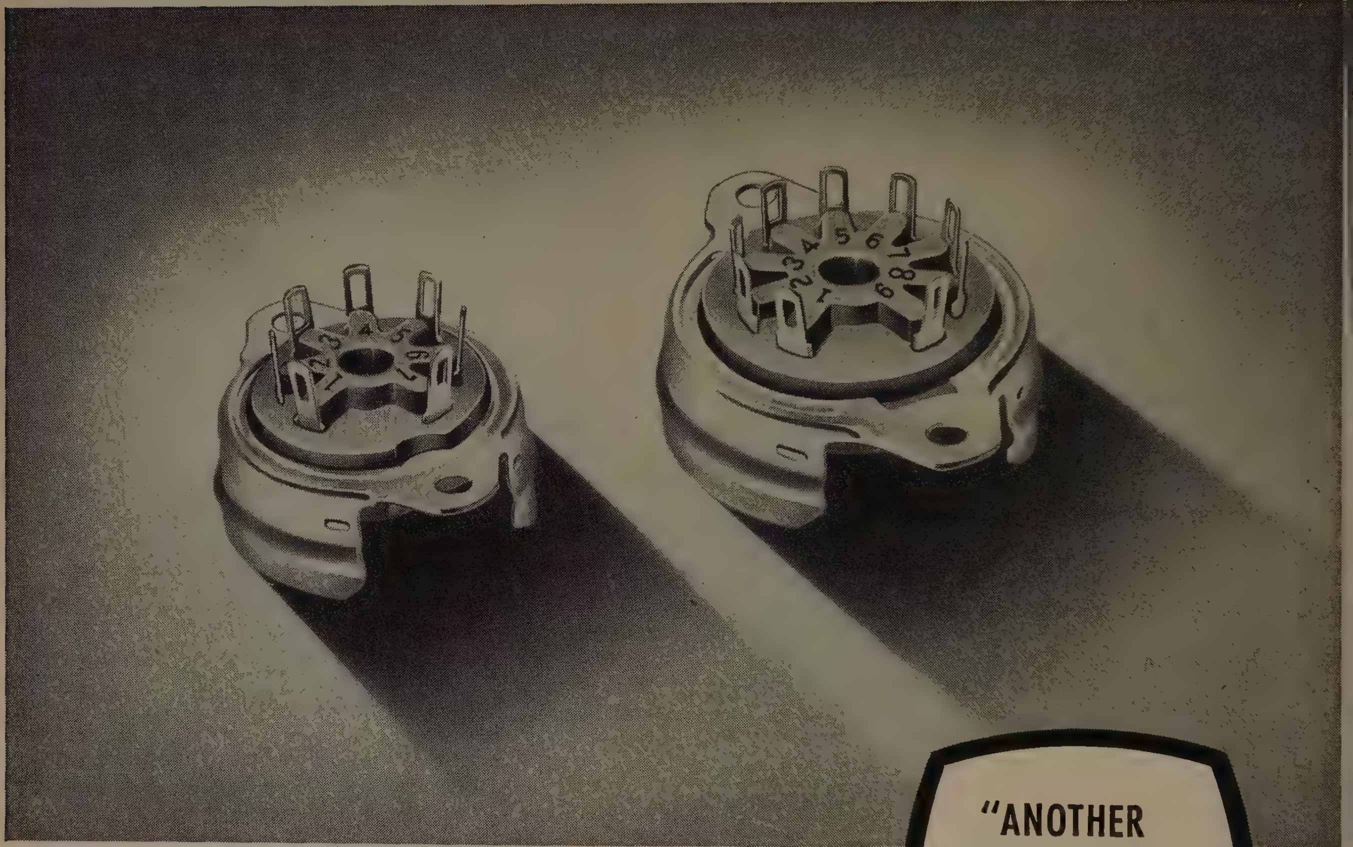
For further details write today to Dept. G-1228A.

AMPEX
ELECTRIC CORPORATION

934 Charter Street, Redwood City, California

Ultra High Quality Sockets

FOR UHF APPLICATIONS



Sylvania now offers you highest quality sockets especially designed for UHF applications. Precision engineered throughout to assure minimum inductance.

Shielded bases and contacts are cadmium plated. Low-loss phenolic castings completely inclose tube pins to prevent shunted circuits.

You'll find it pays to insist on Sylvania ultra high quality parts for all your ultra high frequency requirements. For additional information and specifications, write: Sylvania Electric Products Inc., Dept. 3A-4506, 1740 Broadway, N. Y. 19, N. Y.

"ANOTHER IMPROVED PART... BY SYLVANIA"

SYLVANIA

In Canada: Sylvania Electric (Canada) Ltd.
University Tower Building, St. Catherine Street, Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION

TARGET SELECTION

Hitting the selected target has been a prime problem since man first armed himself. However, unlike the problem which faced the primitive native with his bow and arrow, selecting targets for guided missiles involves many new techniques.

Fairchild's Guided Missiles Division was among the first in this country to undertake the design and development of complete missile guidance systems. The systems have been proven in test missiles flown by all three branches of the Armed Services and are among the most advanced types.

Research in the Fairchild Guided Missiles laboratories includes all the basic guidance systems such as surface-to-air, air-to-air and air-to-surface missiles. The division has developed an engineering and production team experienced not only with guidance systems but also with the aerodynamic, structural and propulsion problems associated with missiles.

ENGINE AND AIRPLANE CORPORATION
FAIRCHILD
Guided Missiles Division
WYANDANCH, L. I., N. Y.

Engine Division, Farmingdale, L. I., N. Y. • Aircraft Division, Hagerstown, Md.

Designed for Application

Grid Dip Meters

Millen Grid Dip Meters are available to meet all various laboratory and servicing requirements.

The 90662 Industrial Grid Dip Meter completely calibrated for laboratory use with a range from 225 kc. to 300 mc. incorporates features desired for both industrial and laboratory application, including three wire grounding type power cord and suitable carrying case.

The 90661 Industrial Grid Dip Meter is similar to the 90662 except for a reduced range of 1.7 to 300 mc. It likewise incorporates the three wire grounding type cord and metal carrying case.

The 90651 Standard Grid Dip Meter is a somewhat less expensive version of the grid dip meter. The calibration while adequate for general usage is not as complete as in the case of the industrial model. It is supplied without grounding lead and without carrying case. The range is 1.7 to 300 mc. Extra inductors available extends range to 220 kc.

The Millen Grid Dip Meter is a calibrated stable RF oscillator unit with a meter to read grid current. The frequency determining coil is plugged into the unit so that it may be used as a probe.

These instruments are complete with a built-in transformer type A.C. power supply and interminal terminal board to provide connections for battery operation where it is desirable to use the unit on antenna measurements and other usages where A.C. power is not available. Compactness has been achieved without loss of performance or convenience of usage. The incorporation of the power supply, oscillator and probe into a single unit provides a convenient device for checking all types of circuits. The indicating instrument is a standard 2 inch General Electric instrument with an easy to read scale. The calibrated dial is a large 270° drum dial which provides seven direct reading scales, plus an additional universal scale, all with the same length and readability. Each range has its individual plug-in probe completely enclosed in a contour fitting polystyrene case for assurance of permanence of calibration as well as to prevent any possibility of mechanical damage or of unintentional contact with the components of the circuit being tested.

The Grid Dip Meters may be used as:

1. A Grid Dip Oscillator
2. An Oscillating Detector
3. A Signal Generator
4. An Indicating Absorption Wavemeter

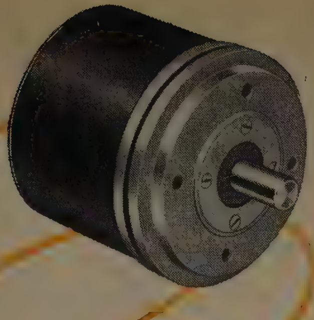
The most common usage of the Grid Dip Meter is as an oscillating frequency meter to determine the resonant frequencies of de-energized tuned circuits.

Size of Grid Dip Meter only (less probe): 7 in. x $3\frac{5}{16}$ in. x $3\frac{3}{8}$ in.

JAMES MILLEN MFG. CO., INC.
MAIN OFFICE AND FACTORY
MALDEN, MASSACHUSETTS, U.S.A.

New!

High Linearity



Infinite Resolution

REVOLUTIONARY, UNIQUE

spiralpot

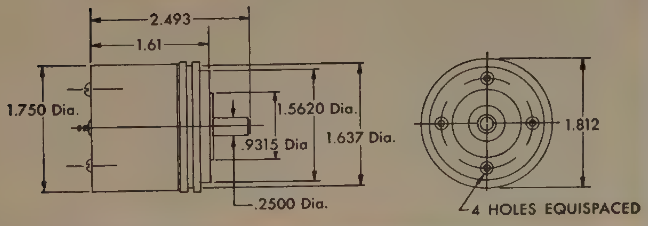
MULTI-TURN SLIDE WIRE
POTENTIOMETER

Long Life

Low Noise

With linearities of ±0.1%, ±0.05% and ±0.025% (both independent and zero based ratings) and rotational tolerances of +1°, −0°, new precision grades of Spiralpot Potentiometers are now available to fill high precision requirements. Designed specifically for high resolution and exceptional linearity applications such as servo control and computers, the Spiralpot can be obtained with shaft rotation up to 7200°. The inherent advantages of a true slide wire action, such as smooth operation, minimum noise and infinite resolution, are increased by design extras such as stainless steel shaft, ball bearings, positive mechanical stops, and a starting torque of less than .6 oz.-in. to give a unit which has extremely long life of over one million cycles (20 million revolutions in a ten-turn unit) and operational shaft speeds up to 500 rpm. These advantages add up to make the Spiralpot one of the biggest advances in precision potentiometer design.

Write for Bulletin 101 A



SPECIFICATIONS

RESISTANCE: 2 ohms/360°, and from 50 ohms/360° shaft rotation to 250 ohms/360° shaft rotation. Standard resistance ranges for 3600° (10-shaft turns) units: 500, 1000, 1500, 2000, 2500 ohms.

POWER RATING: 5.0 watts at ambient = +25°C.

LINEARITIES AVAILABLE: (Based on percent of terminal voltage)

±0.1% Normal (Independent)	±0.1% Zero Base
±0.05% Normal (Independent)	±0.5% Zero Base
±0.025% Normal (Independent)	±0.025% Zero Base

RESOLUTION: Infinite.

MECHANICAL SHAFT ROTATION: For Standard Units (±0.1% linearity). 3600°+3°,−0°.

For Precision Grade Units: 3600° + 1° − 0° (Other linearities)

TORQUE: Starting: less than 0.6 oz.-in. Running: less than 0.3 oz.-in.

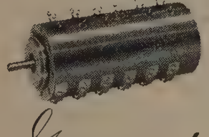
LIFE: Will operate within specifications after one million cycles (20 million revolutions for a 10-turn unit).

TEMPERATURE RATING: Operating range from − 55°C. to + 71°C.

VOLTAGE BREAKDOWN: Will withstand 1000v 60 cycle (rms) for 5 minutes. (At sea level).

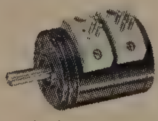
WEIGHT: 4.0 oz.

OTHER GIANNINI POTENTIOMETERS



Gangpot

2½" dia; ¼" shaft; 1 to 6 sections, Aluminum Case; 360° rotation; ±0.3% lin. 4 watts/sec; 2K to 300K ohms; Vernier Screwdriver Phasing. Ball bearings.

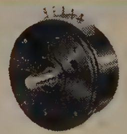


Minigang

1⅛" dia; ¼" shaft; 1 to 6 sections, Aluminum Case; 360° rotation; ±0.5% lin. 2 watts/sec; 500 to 70,000 ohms, Ball bearings.

Rectipot

Straight-line motion along axis. Linear or functional output. 200 to 60,000 ohms. 5 sizes, 1" dia. from 2.33" to 6.54" long. Stroke ⅓" to 5".



Universal

1.74" dia; ¼" shaft; 360° rotation; ±0.3% lin; 4 watts; 2K to 200K ohms, Aluminum Case. Ball Bearings. 40 and 50 db log functions 20K ohms.

Giannini

INSTRUMENT QUALITY
POTENTIOMETERS

G. M. GIANNINI & CO. INC., PASADENA 1, CALIFORNIA—EAST ORANGE, NEW JERSEY

TRIPLETT 630 Volt-Ohm-Mil-Ammeter "speaks" for itself in any company

TRIPLETT 630 Volt - Ohm - Mil - Ammeter has many significant advantages and features that make it stand distinctly apart from similar instruments in its price class. Actually in components, in engineering, in minutely accurate performance, Triplett 630 closely approaches laboratory standards.

Since the scales of any VOM comprise the means by which it makes its multiple services most valuable, the legibility and easy-read-ability are of prime importance. Triplett engineers have created in Triplett 630 the longest scales available in this size tester. (The upper arc by actual measurement is four and three-eighth inches.)

This long-scale factor accounts for the ease with which precise readings are easily made. Further legibility is gained by use of black and red scale markings. D.C. and D.B. are black and white. A.C. and Ohm markings are red on white. Ohms from one hundred million to one-tenth ohm mark the range of this amazing scale. On low ohms, center scale reading is 4.5 ohms.

The Single Switch

Futher indication of the practical skill and engineering "know-how" behind Triplett 630 is the Single Switch. Its simplicity of operation assures no burn-outs thru momentary memory lapses. There is instant switching to desired circuit thru a single 2½" knob flush with the face panel. The molded switch itself embodies the most advanced engineering practices. Fully enclosed, the silvered contacts are kept permanently clean. Its rugged construction means stronger performance and longer life.

These two factors are but samples of the many ways in which on-the-job needs have been anticipated and provided for in a beautiful streamlined tester. It provides A.D-D.C. Volts, D.C. Micro-amperes, Milliamperes, Amperes, Ohms, Megohms, Decibel and Out Put readings in a no-short design embodying interior construction with all direct connections; no harness cabling. Its fool-proof unit switch construction houses precision resistors in insulated recesses in direct connection with switch contacts.

Study the following Ranges and descriptions and compare them point by point with *any* similar instrument for conclusive proof that Triplett 630 "speaks" for itself in *any* company.

Ranges

D.C. Volts: 0-3-12-60-300-1200—at 20,000 Ohms/Volt (For Greater Accuracy on TV and other High Resistance Circuits.)
A.C. Volts: 0-3-12-60-300-1200-6000—at 5,000 Ohms/Volt
(For Greater Accuracy in Audio and other High Impedance A.C. Circuits.)
Decibels: —30, +4, +16, +30, +44, +56, +70. (For Direct Reading of Output Levels.)
D.C. Microamperes: 0-60—at 250 Millivolts.
D.C. Milliamperes: 0-1.2-12-120—at 250 Millivolts.
D.C. Amperes: 0-12—at 250 Millivolts.
***Ohms:** 0-1,000-10,000—(4,4-44 at center scale).
***Megohms:** 0-1-100—(4,400-440,000 center scale).
Output: Condenser in series with A.C. Volt ranges.

**Resistance ranges are compensated for greatest accuracy over wide battery voltage variations. Series Ohmmeter circuits for all ranges to eliminate possibility of battery drain when leaving switch in Ohms position.*

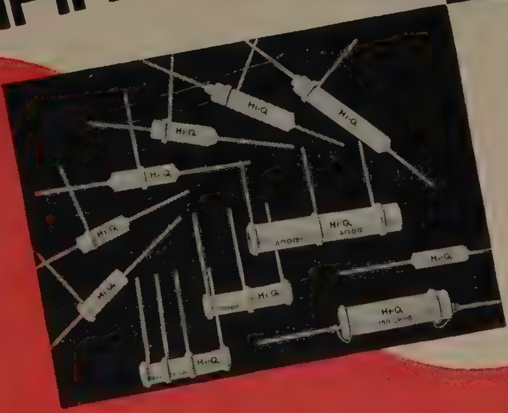
Get a Triplett 630 into your own hands at your distributor.
U.S.A. Dealer Net $3950

TRIPLETT ELECTRICAL INSTRUMENT COMPANY
BLUFFTON, OHIO

TRIPLETT

ceramic capacitors

FUNCTION* FITTED



. . . to your needs

*Not mere ceramic capacitors but units engineered to your circuitry, associated components and operational conditions. HI-Q specialists are ready to collaborate with your engineers for the ideal application.

These trimmers, stand-off capacitors and resistor-capacitor combinations are typical of Hi-Q special components developed largely to meet special needs. They suggest what Hi-Q specialists can accomplish in designing and producing ceramic units for any and all purposes.

Capacitor elements in Hi-Q special components meet all requirements as established by RTMA for Class 2 ceramic dielectric capacitors specifically suited for by-pass and coupling applications, or for frequency discriminating circuits where Q and stability of capacitance are not of major importance. Where Class 1 capacitors are required, Hi-Q specialists are again ready to study your most rigid specifications.

Hi-Q® DIVISION

AEROVOX CORPORATION
OLEAN, N.Y.

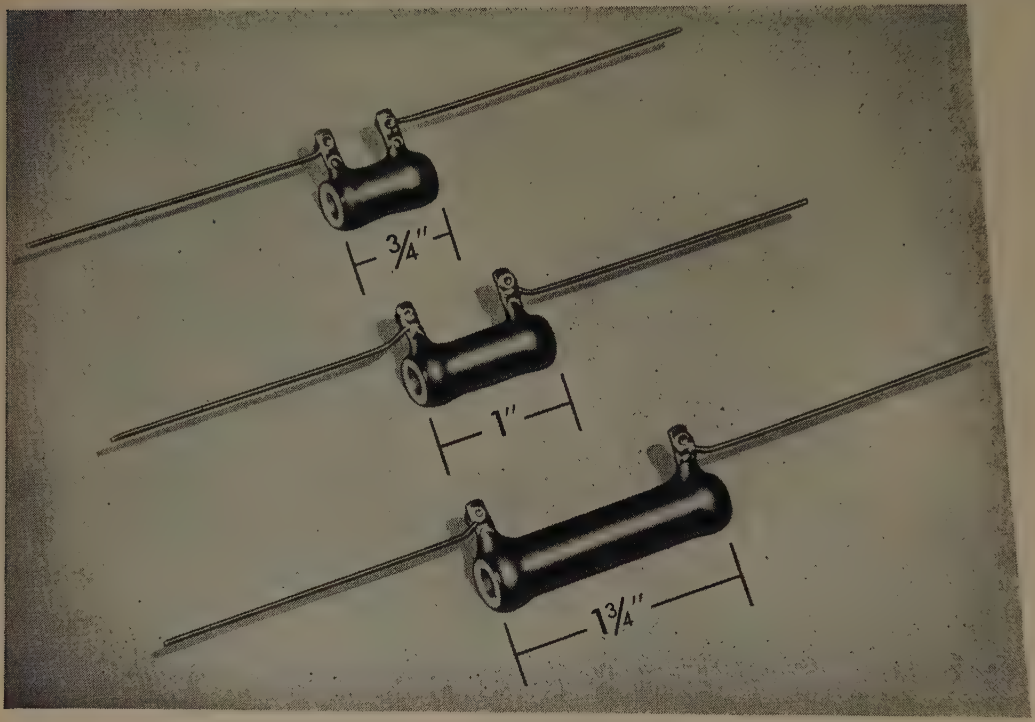
AEROVOX CORPORATION
NEW BEDFORD MASS.

WILKOR DIVISION
CLEVELAND, OHIO

Export: 41 E. 42nd St., New York 17, N. Y. • Cable: AEROCAP, N. Y. • In Canada: AEROVOX CANADA LTD., Hamilton, Ont. JOBBER ADDRESS: 740 Belleville Ave., New Bedford, Mass.

ANNOUNCING . . .

A new line of Mallory Enamel Coated Resistors for television and radio applications



LOW COST

SMALL SIZE

These new Mallory Resistors are ideal for confined areas in television and radio equipment. They are unaffected by moisture and the expansion characteristics of all components are matched to produce a unit impervious to thermal shock.

Cores are identical to those of all Mallory Vitreous Enamel Resistors . . . providing optimum electrical characteristics and great physical strength. Low temperature coefficient wire assures stable resistance values over the entire operating range.

For your resistor requirements, be sure and investigate these new low cost units. They are available in the following ratings:

3 watts, 10-5000 ohms
5 watts, 10-10,000 ohms
10 watts, 25-25,000 ohms

TECHNICAL DATA FOR YOUR FILES

Recent Technical Bulletins on Mallory fixed resistors, carbon and wire wound controls, and capacitors are yours for the asking. Write today.

Expect more . . .
get more
***from* MALLORY**

Parts distributors in all major cities stock Mallory standard components for your convenience

P.R. MALLORY & CO. Inc.
MALLORY

SERVING INDUSTRY WITH THESE PRODUCTS:

Electromechanical—Resistors • Switches • Television Tuners • Vibrators
Electrochemical—Capacitors • Rectifiers • Mercury Batteries
Metallurgical—Contacts • Special Metals and Ceramics • Welding Materials

P. R. MALLORY & CO. INC., INDIANAPOLIS 6, INDIANA

SYNTHANE —out of sight, but in the picture

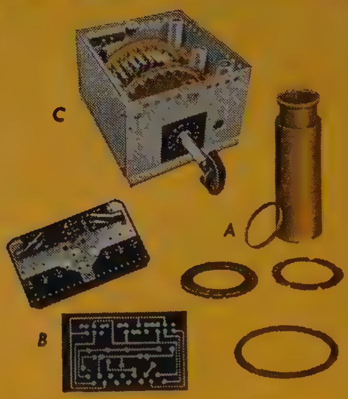
Whenever you turn on television you are using a little-seen, but essential, material called Synthane.

Synthane is a laminated plastic of multiple virtues, which recommend it for many jobs in television.

Synthane is an excellent insulator, laminable with metal, hence, a good base for space-reducing "printed" circuits. Synthane is notable for low power factor, low moisture absorption, and ease of fabrication, three properties desirable for radio and television insulation. Synthane plays a supporting part in many behind-the-screen and behind-the-camera applications.

Synthane is also light in weight, strong, vibration absorbing, chemically resistant, high in dielectric strength, dimensionally stable, heat resistant to about 300°F.

There may be a place for Synthane in your product. To find out more about the possibilities of Synthane for your purpose, write for the complete Synthane Catalog. Synthane Corporation, 12 River Road, Oaks, Pennsylvania.



Synthane in Television . . .

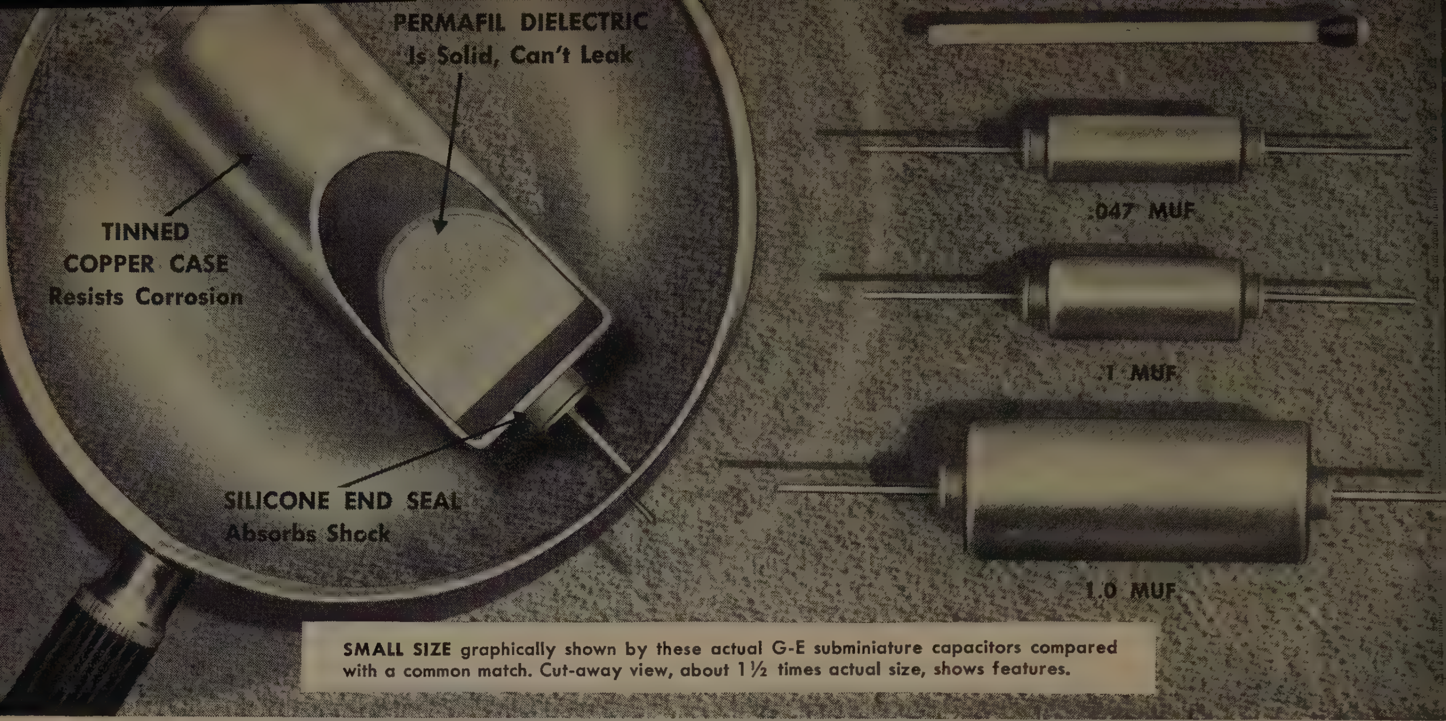
- *A—Television camera parts*
- *B—Television receiver printed circuits—metal foil on Synthane sheets*
- *C—Channel selector switch insulation*

Synthane—one of industry's unseen essentials

SYNTHANE

S

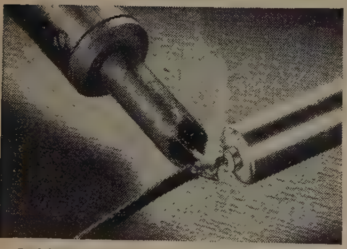
LAMINATED PLASTICS



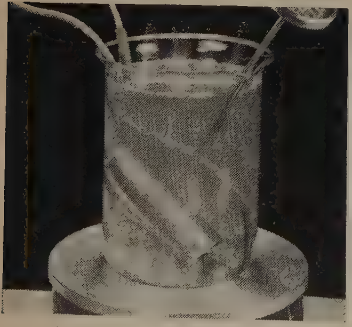
SMALL SIZE graphically shown by these actual G-E subminiature capacitors compared with a common match. Cut-away view, about 1½ times actual size, shows features.

New G-E subminiature metal-clad capacitor line features solid dielectric and silicone end seals

FOR OPERATION FROM −55 C TO +125 C WITHOUT DERATING



Solder right up to the bushing with G-E Silicone end seal—no danger of cracking glass.



At +125 C—100% capacitance

At −55 C—less than 7% loss

Designed specifically for electronic equipment, this new line of General Electric subminiature capacitors provides the utmost reliability under the most severe operating conditions combined with small size, no liquid leakage, and high insulation resistance. They will operate from −55 C to +125 C without derating and up to +150 C with proper derating.

These G-E subminiature metal-clad capacitors meet all test requirements of JAN-C-25 and the proposed MIL-C-25A and can be supplied in both tab and exposed foil designs.

Excellent electrical characteristics are assured by the use of Permafil solid dielectric. Capacitance varies only 1 percent over the temperature range from 0 C to +125 C and only 7 percent over the entire range from −55 C to +125 C.

Exceptional shock resistance provided by exclusive G-E silicone end seals. This seal meets the moisture resistance tests of JAN-C-25 with d-c potential applied.

Muf ratings of these new G-E subminiature capacitors range from .001 to 1.0 muf in voltage ratings of 100, 200, 400 and 600 volts d-c working. They can be operated at full voltage up to altitudes of 50,000 feet.

Case sizes range from .235 inches in diameter and $\frac{11}{16}$ in length to 1 inch diameter and $2\frac{5}{8}$ inches in length.

Liquid-filled metal-clad line also available with G-E Pyranol* dielectric for operation from −55 C to +85 C **without derating.** These subminiature capacitors also incorporate the silicone end seal for maximum shock resistance and can be supplied in either tab or foil designs in ratings from .001 to 1.0 muf in voltages of 100, 200, 400, and 600 volts d-c working.

If your requirements demand the highest performance standards for subminiature capacitors, check with your nearest G-E Apparatus Sales Office for exact delivery information . . . or write to General Electric Company, Section 442-8, Schenectady 5, N. Y.

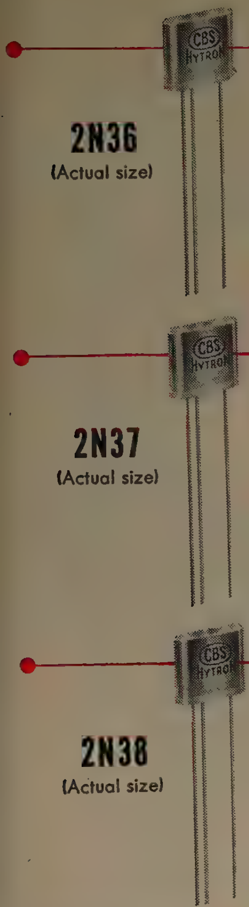
1878 75 1953
YEARS OF ELECTRICAL PROGRESS

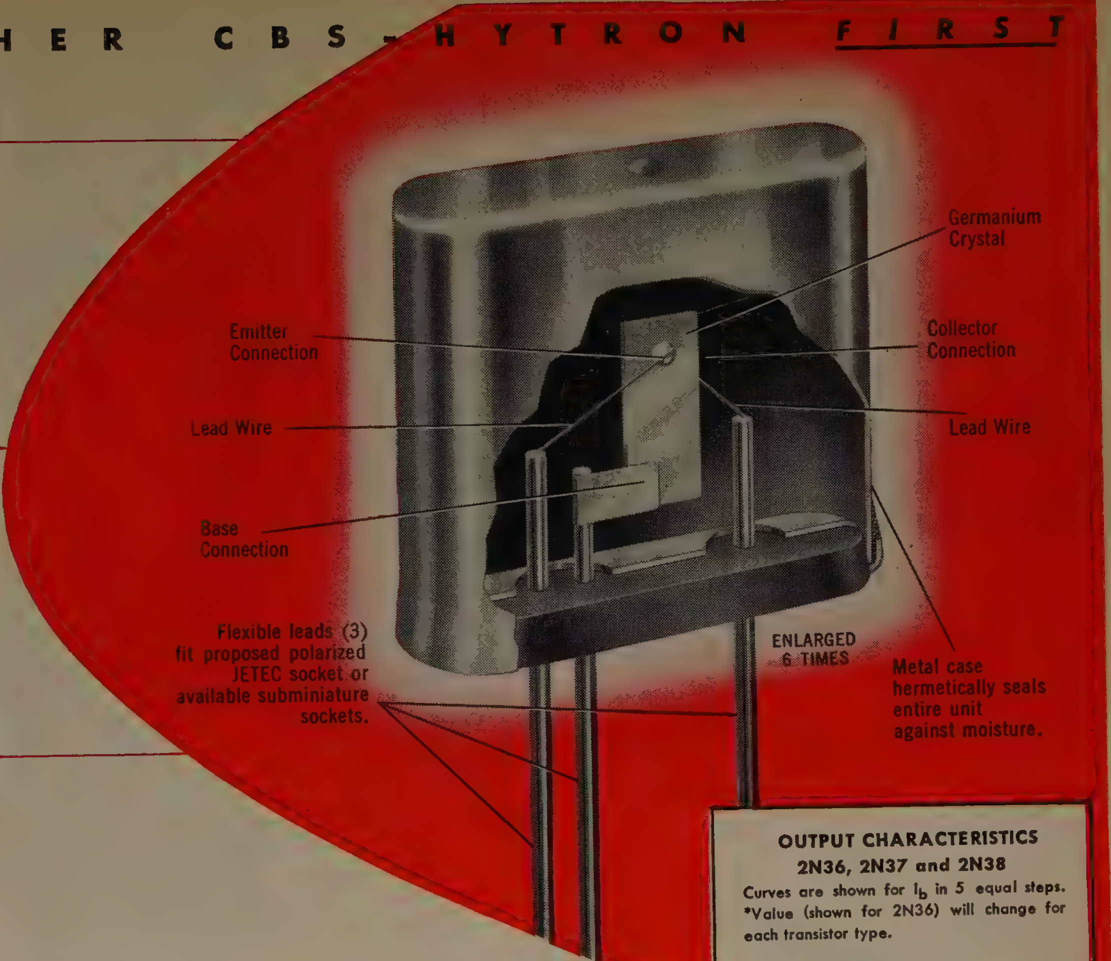
*Registered trade-mark of General Electric Company.

You can put your confidence in—

GENERAL ELECTRIC

ANOTHER CBS-HYTRON FIRST





Flexible leads (3) fit proposed polarized JETEC socket or available subminiature sockets.

Metal case hermetically seals entire unit against moisture.

NOW...HERMETICALLY SEALED CBS-HYTRON JUNCTION TRANSISTORS

In junction transistors, the surfaces are extremely sensitive to moisture. For dependability, they must be completely moisture-proofed. CBS-Hytron, recognizing this, is the first to offer you the new *hermetically sealed* 2N36, 2N37, and 2N38 junction transistors. Each is uniquely sealed in a metal case . . . moisture-proof, contamination-proof, light-proof. (See drawing.)

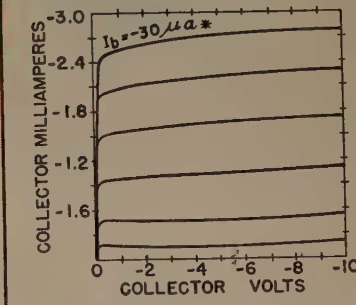
You can buy these new hermetically sealed P-N-P junction types immediately. All are amplifier types. Have similar characteristics, except for current amplification and power gain. You may operate the 2N36, 2N37, 2N38 up to 55°C. Their in-line design gives you: Compact, flat mounting . . . easily identified polarity . . . solder-in or plug-in (with clipped leads) convenience.

In addition to their unique moisture-proof feature, these CBS-Hytron junction types offer: (1) High gain. (2) Low noise figure. (3) Operation at low voltages. As well as other advantages characteristic of transistors: Compactness . . . light weight . . . ruggedness . . . instantaneous operation . . . and long life.

Remember, CBS-Hytron hermetically sealed 2N36, 2N37, 2N38 transistors are available at once. Write for complete data. Or order now for prompt delivery.

OUTPUT CHARACTERISTICS
2N36, 2N37 and 2N38

Curves are shown for I_b in 5 equal steps. *Value (shown for 2N36) will change for each transistor type.



ELECTRICAL CHARACTERISTICS†
CBS-Hytron P-N-P Junction Transistors

Characteristic	2N36	2N37	2N38	
Collector voltage	—6	—6	—6	v
Collector current	—1	—1	—1	ma.
Current amplification factor #	45	30	15	
Power gain #	40	36	32	db

†Typical values at 25°C. #Grounded emitter connection.

NOW 3 CBS-HYTRON TEST ADAPTERS. By popular demand. Three sizes now available at these net prices: 7-Pin Miniature, $1.45; 8-Pin Octal, $2.25; 9-Pin Miniature, $1.75. Take advantage of e-a-s-y "topside" testing. Order your Test Adapters today from your CBS-Hytron jobber.

CBS HYTRON

Manufacturers of
Receiving Tubes Since 1921

CBS-HYTRON Main Office: Danvers, Massachusetts

A Division of Columbia Broadcasting System, Inc.

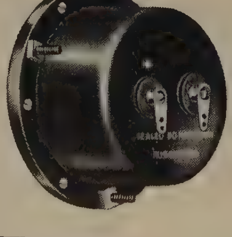
RECEIVING . . . TRANSMITTING . . . SPECIAL-PURPOSE AND TV PICTURE TUBES • GERMANIUM DIODES AND TRANSISTORS

WESTON Ruggedized Instruments

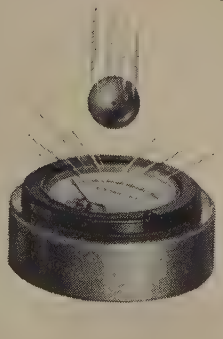
have *EXCLUSIVE* zero correctors

Ruggedized and Sealed without any compromise!
.2
.4
.6
.8
MILLIAMPERES
D.C.
WESTON

No desirable instrument features were sacrificed in order to produce these truly ruggedized and effectively sealed instruments. With typical WESTON thoroughness, every feature has been retained including even the zero corrector. And *true* ruggedness has been achieved by new but thoroughly proved design concepts, such as shock-resistant spring backed jewels . . . flat windows of tough, anti-static, and glare reducing plastic . . . new high-strength tubular pointers, and a method of shock mounting and sealing that assures accurate indications under extremes of shock, vibration, temperatures, humidity, and downright abuse. Available in 2½" and 3½" D-C, R-F, A-C movable iron and rectifier types. WESTON Electrical Instrument Corporation, 614 Frelinghuysen Avenue, Newark 5, New Jersey.



Connection terminals molded into internal rubber increase current carrying capacity.



Tough, flat plastic windows reduce glare and are *really* shock resistant.

WESTON
Instruments

HERE OR ABROAD

It's Wilcox Type 482 TVOR

For Improved Safety and Regularity of Operatio
Under Adverse Weather Conditions . . .

. . . designed and built by the manufacturers who supplied basic equipments for the *first* TVOR installation ever made.

Wilcox TVOR installations, here and abroad, have supplied us with a wealth of information that has been incorporated in our low cost production model TVOR equipment. Just one of the main problems solved is flexibility of siteing. Wilcox solved this with the unique design features of the prefabricated Wilcox TVOR housing unit.

When considering TVOR equipment . . . consider Wilcox, major supplier to the CAA, the military services, and airlines of the world.

Write now for full information and delivery schedule on Wilcox Type 482 TVOR Equipment.

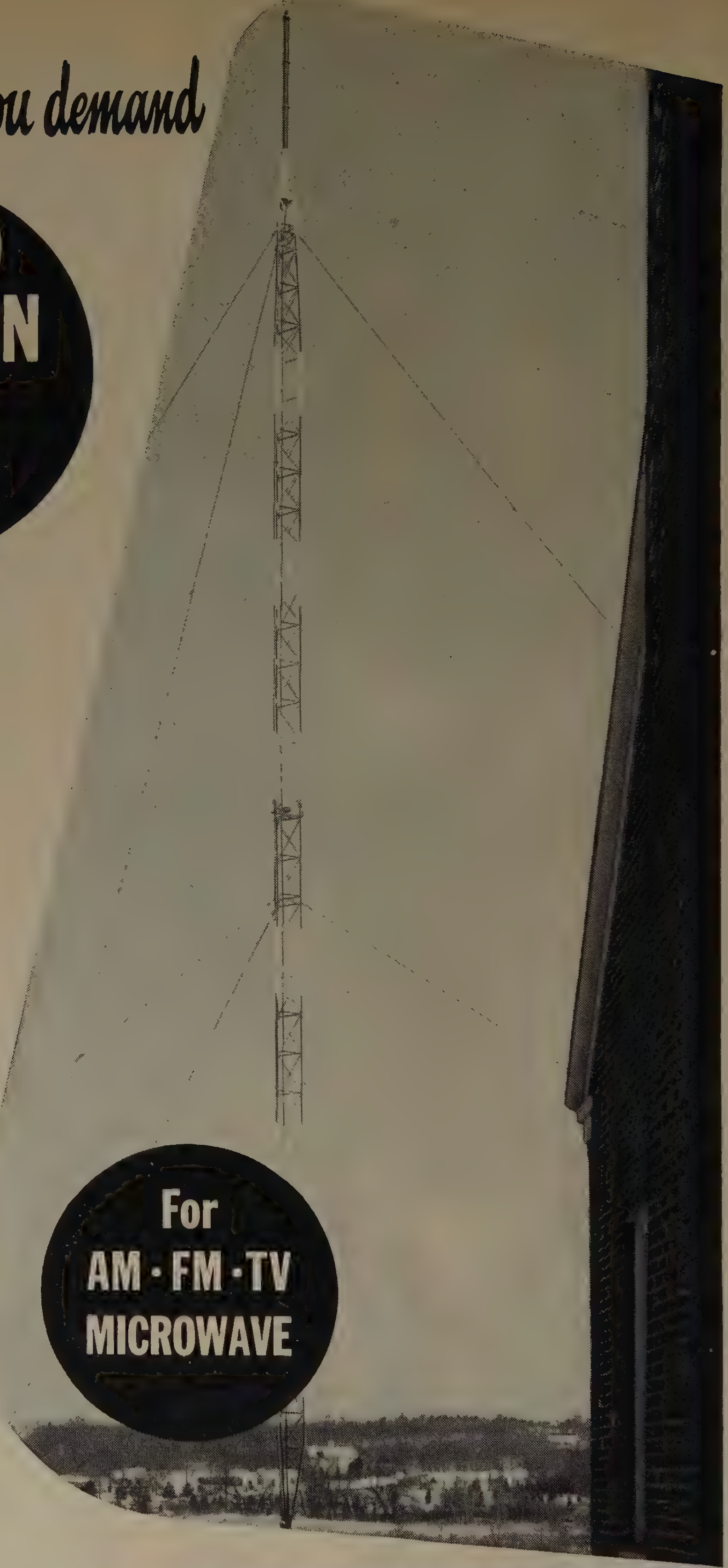
wilcox

ELECTRIC COMPANY, INC.
Fourteenth & Chestnut
Kansas City 27, Missouri, U.S.A

Original manufacturers of Terminal VHF Omni-Range Equipment.

For the Performance you demand

TALK TO TRUSCON ABOUT TOWERS



For AM · FM · TV MICROWAVE

Most of all you want *dependable* tower performance. The kind of performance that helps keep your signal on the air day-in day-out, year-in year-out . . . whatever the weather. That's why it pays to talk with Truscon.

Truscon's background of tower experience is unmatched. It's in the minds and hearts of men who have designed, engineered and manufactured so many hundreds of towers that now stand strong and tall in all types of topography—exposed to all extremes of wind and weather.

Truscon manufacturing facilities are modern and efficient...geared to the production of tall and small towers . . . guyed and self supporting . . . tapered or uniform in cross-section . . . for AM, FM, TV and Microwave transmission.

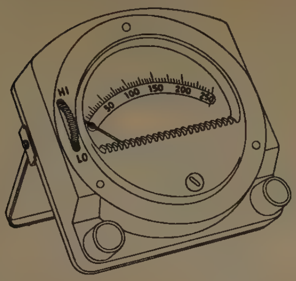
Benefit from this broad experience. Use this knowledge. Write or phone your nearest Truscon district office or "tower headquarters" in Youngstown to get your tower program started as soon as defense requirements allow.

TRUSCON
MARK OF MERIT
PRODUCTS

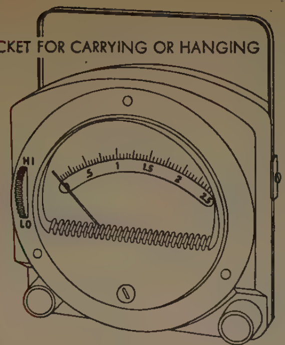
TRUSCON® ...a name you can build on

Truscon Steel Division
REPUBLIC STEEL CORPORATION
1072 ALBERT ST. • YOUNGSTOWN 1, OHIO

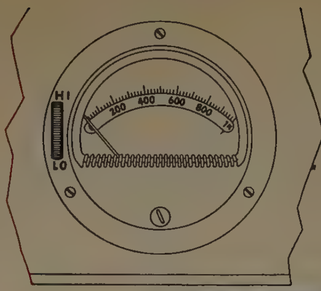
30° FOLDING BRACKET



BRACKET FOR CARRYING OR HANGING



MOUNTED IN PANEL



The Marion Multi-Dialer Model MD-1 shown here (ruggedized movement) is available with five self-contained ranges in volts, milliamperes, microamperes and amperes. It is also available custom-engineered to your end-product so that it may be installed on your panel and when appropriate scale is selected it will automatically insert the instrument with appropriate accessories into five separate measuring circuits and/or ranges in your equipment.

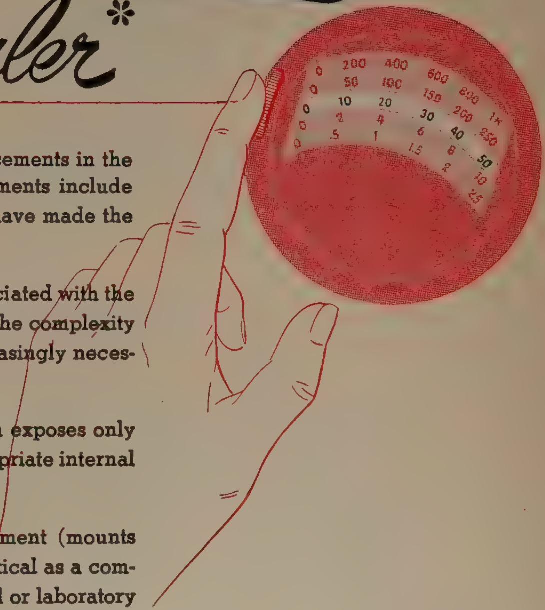
PATENT PENDING

THE *confusion-proof* METER

NEW

Width 3 9/16″
Height 3¾″
Depth 1 23/64″

marion *Multi-Dialer**



Better Meters Made Easier To Use. Recent years have seen major advancements in the performance characteristics of electrical indicating instruments. These advancements include Marion's pioneer work in the fields of hermetic sealing and ruggedization. They have made the electrical indicating instrument of today an extremely reliable device.

However, very little attention has been paid to the bio-mechanical problems associated with the proper use and interpretation of the intelligence presented by the instrument. As the complexity of application, particularly in the multi-scale type has grown, it has become increasingly necessary to attack and solve these human error problems.

The Marion Multi-Dialer was developed to provide a multi-scale instrument which exposes only one scale to view at a time. At the same time, it automatically switches the appropriate internal or external circuitry associated with that scale.

The Multi-Dialer may be used as a panel instrument (mounts to standard JAN-3½″ dimensions). It is also practical as a complete, self-contained, portable instrument for field or laboratory use. Its ingenious combination handle and stand makes it convenient to use on or above the bench.

Marion Electrical Instrument Company
407 Canal St., Manchester, New Hampshire

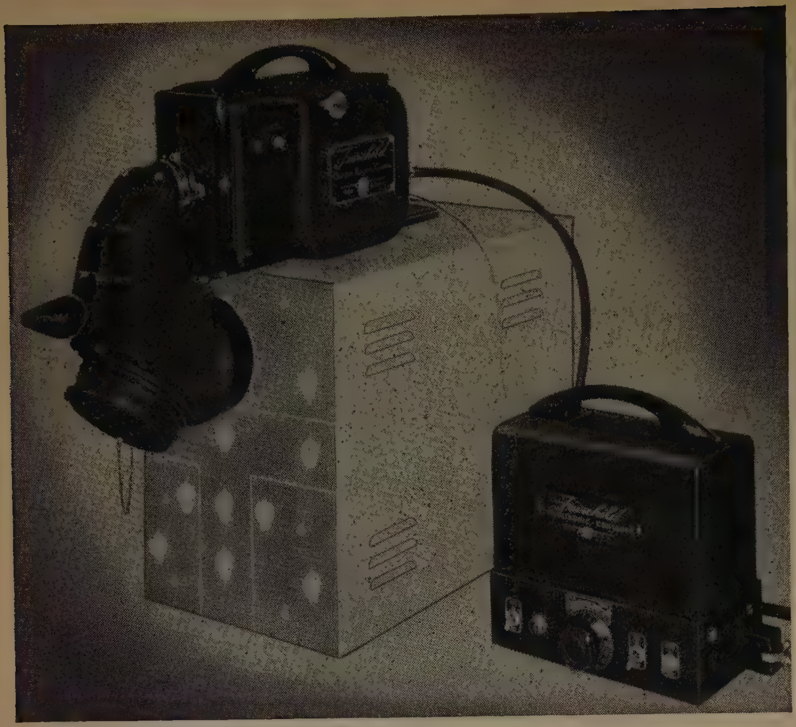
*Trade Mark

Copyright 1953 Marion Elec. Instr. Co.

® Reg. U. S. Pat. Off.

marion meters

MANUFACTURERS OF RUGGEDIZED AND "REGULAR" METERS AND RELATED PRODUCTS



YOU GET THESE ADVANTAGES

with the FAIRCHILD OSCILLO-RECORD CAMERA

DESIGNED FOR both still and continuous-motion photography on 35-mm film, the Fairchild Oscillo-Record Camera records non-recurring phenomena that are too rapid for visual study, others that are so slow that continuity is lost, and the occasions where very high-speed transients are combined with very slow-speed phenomena. Oscillo-Record camera users especially like these advantages:

1. POSITIVE FILM DRIVE—Film is sprocket-driven synchronously with the take-up spool to prevent slippage and jamming at high speeds.

2. CONTINUOUSLY VARIABLE SPEED ADJUSTMENT—Film speed is electronically controlled over range of 1 to 3600 in. per min. No belts or pulleys are required.

3. TOP-OF-SCOPE MOUNTING—Controls are easily accessible. No tripod is needed.

4. VERSATILITY—Designed for both still and continuous-motion photography on 35-mm film. Provision for three lengths—100, 400, or 1,000 ft. For quick development and study of short lengths of film (up to 10 ft.) a special take-up cassette is available to help save time and reduce film wastage.

Fairchild-Polaroid® Oscilloscope Camera Provides Easy-to-Read Prints

For individual exposures the Fairchild-Polaroid Oscilloscope Camera provides speed, convenience, and economy. Trace reads normally—left to right. Reduction is exactly one-half size for easy measurement of values, especially with a grid. Each print is 3¼ x 4¼ and records two images.

One minute after you pull the tab, a finished print is ready for evaluation.

Complete information about applications and operation of the Fairchild Oscillo-Record and Fairchild-Polaroid Cameras awaits your request. Write today to *Fairchild Camera and Instrument Corporation, Robbins Lane, Syosset, Long Island, New York, Department 120-20C.*

FAIRCHILD
OSCILLOSCOPE RECORDING CAMERAS

Now FOR THE FIRST TIME

25 KW AT 220 MC!

SUPER-POWER! 25 kw output at sync. peak level.

LOW DRIVE! 10-to-1 tube gain.

ALL V-H-F TV BANDS! 220-mc frequency at max ratings.

ULTRA-MODERN! Ring-seal design; ceramic construction.

COMPACT! Approx. 14" high.

NEW GL-6251 POWER TETRODE

Makes SUPER-POWER available to TV Transmitter Designers!

Two GL-6251's in your new v-h-f circuit will boost E. R. P. to the *full authorized 316 kw!*

Here's a plus: only 5 kw is needed to drive a pair of these high-gain tetrodes! Low-power TV transmitters now on the air—by adding an amplifier stage with two GL-6251's—can increase signal strength to top levels at moderate cost.

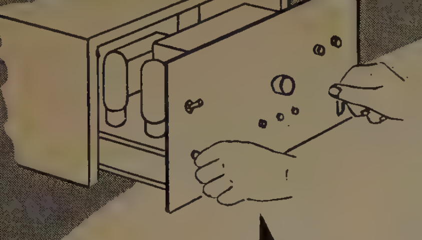
Manufacture and sale of these amplifier circuits to TV stations, is a profit opportunity for you second only to that from applying GL-6251's in new high-power v-h-f transmitters, where your customers require maximum E. R. P. from the start.

GL-6251 is the *big* new tube for your *big* jobs! Get complete information about this SUPER-POWER tetrode from *Tube Department, General Electric Company, Schenectady 5, New York.*

163-1A6

GENERAL ELECTRIC

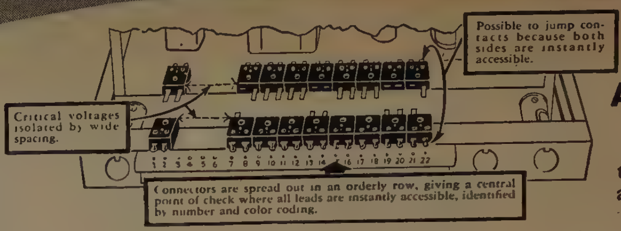
Picture YOUR PRESENT CHASSIS with these advantages



INSTANT REMOVAL

FROM FRONT

for servicing or plugging in replacement spare.



Possible to jump contacts because both sides are instantly accessible.

Critical voltages isolated by wide spacing.

Connectors are spread out in an orderly row, giving a central point of check where all leads are instantly accessible, identified by number and color coding.

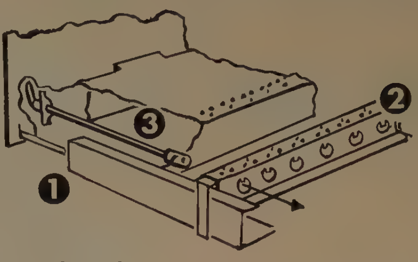
100% ACCESSIBILI

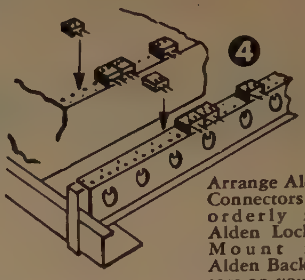
AT BACK

to check all incom
and outgoing lea

IT'S AS SIMPLE AS THIS

Arrange Alden Side Rails (1) and Alden Lock Frame (2) to suit your chassis. Alden Serve-A-Unit Locks (3) mount in your chassis to engage prepunched holes in Alden Lock Frame (2) to pilot, draw in, lock or eject.



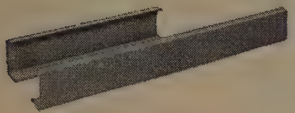


Arrange Alden B
Connectors (4)
orderly row
Alden Lock Fra
Mount mati
Alden Back Conn
tors on your chas

All you need is this simple Alden Serve-A-Unit Kit —

① **ALDEN SIDE RAILS**

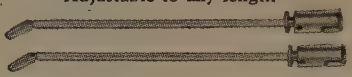
ANY LENGTH



② **ALDEN LOCK FRAME**

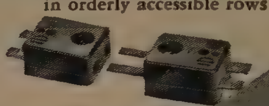
ANY LENGTH

③ **ALDEN SERVE-A-UNIT LOCKS**
Adjustable to any length



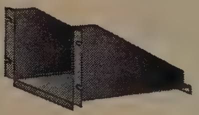
ALDEN UNIVERSAL BRACKET
Joins Lock Frame to Side Rails

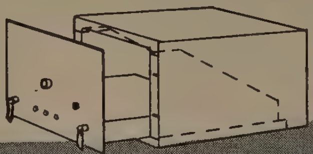
④ **ALDEN BACK CONNECTORS**
Keep leads spread out
in orderly accessible rows



If you want it, here's a RACK ADAPTER —

ALDEN UNIVERSAL RACK ADAPTER



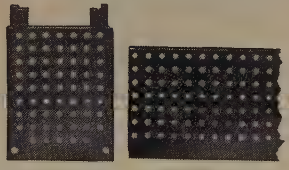


You can arrange Side Rails and Lock Frame so your chassis plugs into this Rack Adapter.

ALDEN COMPONENTS FOR PLUG-IN UNIT CONSTRUCTION

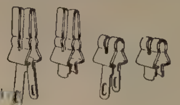
Why not design new circuitry in compact vertical planes It's as simple as this

USE ALDEN'S TERMINAL CARD MOUNTING SYSTEM



ALDEN PREPUNCHED TERMINAL MOUNTING CARDS cut to proper sizes for 7-pin, 9-pin, 11-pin and 20-pin packages. Or in 3' strips for chassis — cut it off as you require.

+



ALDEN MINIATURE STAKING TERMINALS Lay out in any pattern on Terminal Mounting Cards; ratchet slots hold elements for soldering without pliering or wrap-around.

+

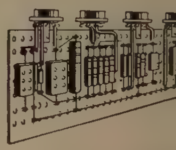
ALDEN JUMPER STRIP stakes right under Terminals providing common circuit without soldering.

+

ALDEN CARD-MTG. TUBE SOCKETS for min. 7-pin, 9-pin and octal tubes.

=

Typical circuitry for 20" package

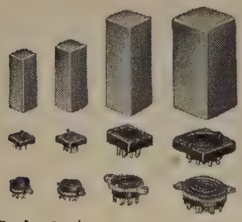


Typical circui
for chassis

-and how beautifully these vertical units fit into plug-ins It's as simple as thi

USE ALDEN PLUG-IN PACKAGES AND BASIC CHASSIS COMPONENTS

4 SIZES OF PLUG-IN PACKAGES



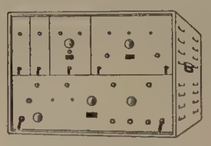
7-pin 9-pin 11-pin 20-pin

Package components and matching sockets.

HUNDREDS of COMBINATIONS with these COMPONENTS

COLOR-CODED HANDLE directs package to color-coded socket.

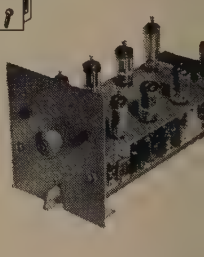
4 SIZES OF PLUG-IN CHASSIS



ALDEN UNI-RACK

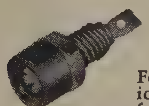
Mount vertical planes of circuitry in Alden Basic Chassis, with Alden Back Connectors and Alden Serve-A-Unit Lock as above.

ALDEN BASIC CHASSIS



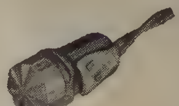
-and assign to each unit a tiny tell-tale to spot trouble instantly It's as simple as th

USE ALDEN SENSING ELEMENTS



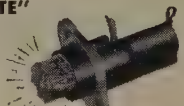
ALDEN MINI-TEST POINT JACK

For checking critical voltages from front of panel.



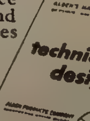
ALDEN "PAN-i-LITE"

Miniature indicator light with unbreakable 1-piece light-lens unit replaceable from front.



ALDEN "FUSE-LITE"

Fuse blows — Lite glows. Simple unscrew 1-piece light-lens unit and blown fuse comes out with it.



techni
desi

GET THE COMPLETE STORY — REQUEST "ALDEN HANDBOOK" — SENT FREE

the switch is ON to GUARDIAN

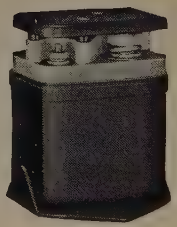
GOVERNMENT APPROVED

Interchangeable AIRCRAFT RELAYS

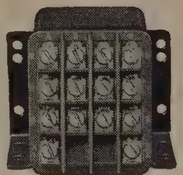
Important to **AIRCRAFT DESIGN ENGINEERS . . .** the complete *interchangeability* (on the same mounting base) of this new line of Guardian Aircraft Relays allows for constantly changing power and performance requirements. Units range from single pole, single throw (time delay available) to four pole, double throw contact combinations, with ratings from 10 amperes to 50 amperes at 28 v., D. C. All sealed in accordance with MIL-R-6106. Weights: from 7.5 ounces to 20.8 ounces.

Imagine the *flexibility* made possible at the design, modification and retrofit stages by standard spacing of mounting bracket holes which permits complete *interchangeability* of these highly reliable new Guardian Aircraft Relays. **This is the way to meet new control specifications with *no changes* in frame drawings.** Dimensions vary *only* between back plates and terminals on face plates.

The *interchangeable* feature of these Guardian Aircraft Relays is an important contribution to adaptability of equipment design, so essential in these days of constantly changing control characteristics. For replacing relays *after* assemblies get under way, or for aircraft maintenance and modernization, these *interchangeable* Guardian Aircraft Relays are a practical "must"! Write for Bulletin 1 A R.

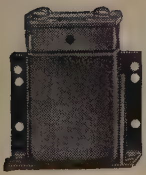


200 Ampere
Solenoid Contactor



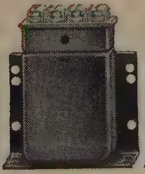
MS-25024-1 RELAY
Interchangeable
10 Amp 4 P.D.T.

NOTE THE PRECISE ALIGNMENT OF MOUNTING HOLES!

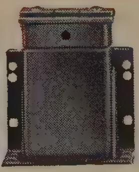


25 Amp
S.P.D.T.

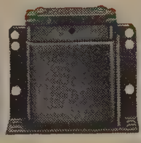
10 Amp
3 P.D.T.



10 Amp
4 P.D.T.

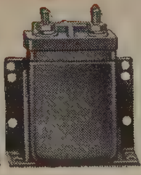


10 Amp
S.P.D.T.



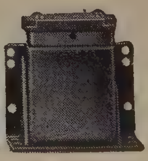
10 Amp
2 P.D.T.

10 Amp
3 P.D.T.



50 Amp
S.P.D.T.

10 Amp
3 P.D.T.



10 Amp
2 P.D.T.

Specify from Guardian's complete range for every advantage of quick interchange!

GUARDIAN ELECTRIC

1628-G W. WALNUT STREET
CHICAGO 12, ILLINOIS

A COMPLETE LINE OF RELAYS SERVING AMERICAN INDUSTRY

Accurately Tests and Calibrates Omni-Range and ILS Receiving Equipment

SIGNAL GENERATOR

Type 211-A

Frequency Range 88-140 mc.

Output Frequency Crystal Monitored
Amplitude Modulation 0-100%
Modulation Fidelity ±0.5 db
30 cycles to 11 kilocycles
Negligible Spurious FM

The Type 211-A Signal Generator was designed by Boonton Radio Corporation in cooperation with the CAA and leading manufacturers of aircraft navigation and landing receivers. It was designed for specific application to the calibration of these receivers to the high accuracy characteristics required. The CAA system requiring these receivers guides aircraft from one location to another and assists in landing under marginal weather conditions. The Signal Generator is also useful in testing accurately tuned communications receivers.

SPECIFICATIONS

FREQUENCY RANGE: 88 to 140 mc. in one Range. Vernier Dial marked to 10 Kc. division. Accuracy ± 0.25%.

R. F. OUTPUT: 0.1 to 200,000 microvolts. Output resistance looking into output terminals 26.5 ohms.

AMPLITUDE MODULATION: AM 0-30% and 0-100% with internal or external oscillator. Distortion below 5% at 95% modulation.

INTERNAL AUDIO OSCILLATOR: 400 and 1000 cps.

MODULATION AMPLIFIER: Uniform response within ± 0.1 db 90 to 150 cps. and 9.5 to 10.5 Kc. within ± 0.5 db 30 cps. to 11 Kc.

PHASE DISTORTION: Up to 60% modulation less than 0.25 degrees at 30 cps and 10 degrees at 11 Kc.

SPURIOUS FM: Less than 1 Kc. at 60% FM.

CRYSTAL CALIBRATING FREQUENCIES: 110.100 and 114.900 mc. ± 0.0035%. Calibrations can be made at these and other frequencies by slipping dial vs condenser shaft position.

PRICE: $1800.00 FOB Boonton, N. J. (Relay Rack not included).

Glide Slope Signal Generator

Type 232-A

Frequency Range 329-335 mc.

The 232-A Glide Slope Signal Generator provides 20 crystal controlled frequencies between 329 and 335 mc for testing aircraft landing receivers. One crystal controlled frequency is provided for the IF amplifier of the receiver.

The 232-A is a completely self-contained signal generator including its own power supply and synchronous motor driven modulator. It is a complete test equipment for Glide Slope Receivers.

SPECIFICATIONS

FREQUENCY RANGE: 329 to 335 mc (20 crystal controlled frequencies).

FREQUENCY ACCURACY: ± 0.0065%.

OUTPUT LEVEL: 1 to 200,000 microvolts.

OUTPUT IMPEDANCE: 53 ohms unbalanced.

IF FREQUENCY: 18.9 mc (By changing crystal 15 to 30 mc).

MODULATION: 90-150 cps, 1000 cps, external.

PRICE: $1500.00 FOB Factory.

BOONTON RADIO Corporation
BOONTON·N·J·U·S·A·

BRC

ONE OF THESE 4

CLARE RELAYS

will meet most exacting small-space requirements

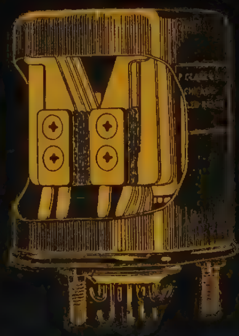
CLARE TYPE K RELAY

First small size, lightweight telephone type relay. Famous for operating speed and resistance to vibration.

TYPE KX—Adds greater operating range and sensitivity with slightly longer coil.

TYPE R—Adds 120% greater sensitivity and 200% greater operating range than Type K.

TYPE N—Operates on less than 50 milliwatts with 10,000 Ohm coil, 1 form C contact and standard adjustment.



HERMETICALLY SEALED RELAYS

Type N Relay hermetically sealed in steeled container... a feature available with all Clare relays.

CLARE pioneered the small-relay field with the Type K relay. Since that time it has been the mainstay of design engineers who must have a superior relay to operate in extremely small space.

The Clare Type K not only has the advantages of small size and light weight but it is capable of exceedingly fast operation, gives adequate contact pressure and is highly resistant to shock and vibration. Its long life and all-around dependability have enabled this relay to meet many complex engineering requirements.

In order to meet customers' specifications which the Type K would not quite fill, Clare engineers have developed three other small, light weight relays. All retain the basic operating and physical characteristics of the Type K. Two of them, the Type KX and the Type R, have the famous Clare reed armature suspension of special alloy. This has long been recognized as one of the subtler reasons for the superior performance of the Clare Type K relay.

The Type KX adds greater operating range and sensitivity by use of a slightly longer coil which can be safely wound to 8000 ohms resistance. The Type R adds still greater operating range and sensitivity by use of a coil not only longer but of greater diameter. The Type N relay is designed for operation on very low power. It employs a close-coupled magnetic circuit, generous use of magnetic iron and highly efficient coil design. This permits high sensitivity while retaining high contact pressure (minimum 30 grams) and adequate contact gap (minimum 0.0015″).

All these relays are available enclosed in hermetically sealed gas-filled containers which increase their life, reliability and usefulness under extreme conditions of altitude, temperature, moisture, fungi, dust and dirt.

Clare sales engineers are located near you. For complete information call the nearest Clare office or contact: C. P. Clare & Co., 4719 West Sunnyside Avenue, Chicago 30, Illinois. In Canada: Canadian Line Materials Ltd., Toronto 13. Cable Address: CLARELAY.

FIRST IN THE INDUSTRIAL FIELD

CLARE RELAYS

The Spotlight's On

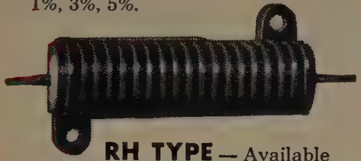
DALOHM

Miniature

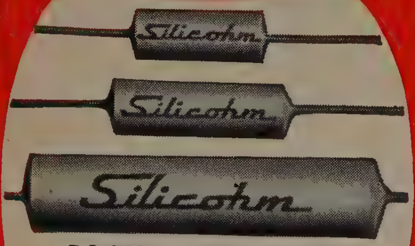
POWER RESISTORS!

WIRE WOUND—SILICONE COATED RESISTORS

Complete welded construction from terminal to terminal. Temperature coefficient 0.00002/ deg. C. Ranges from 0.1 Ohm to 55,000 Ohms, depending on Type. Tolerance 0.05%, 0.1%, 0.25%, 0.5%, 1%, 3%, 5%.

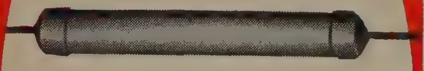


RH TYPE — Available in 25, 50 and 250 watt sizes. Silicone sealed in die-cast, black anodized radiator finned housing for maximum heat dissipation.



RS TYPE — Available in 2 watt, 5 watt, and 10 watt sizes. Silicone sealed offering maximum resistance to abrasion, high thermal conductivity and high di-electric strength.

DEPOSITED CARBON RESISTORS



Dalohm precision deposited carbon resistors offer the best in accuracy, stability, dependable performance and economy. Available in ½ watt, 1 watt and 2 watt sizes.

Carefully crafted in every respect, Dalohm resistors are true power in miniature — provide the answer to those space problems.

Write, wire or phone George Risk
1302 28th Ave., Columbus, Nebr.
for price and delivery   Telephone 2139

DALE

DALE PRODUCTS, INC.

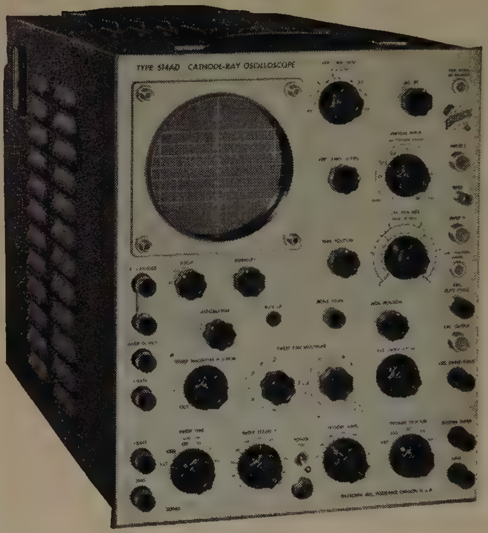
In Canada: [illegible] Corp., Ltd.
Toronto and Montreal

NEW

Oscilloscope

TO SUCCEED THE POPULAR TYPE 514-D

THE Type 514-AD



- **New Vertical Amplifier**
  6 cm undistorted vertical deflection
- **New Precision Flat-Faced 5″ CRT—improved geometry and edge focus**
- **New Variable Duty Cycle Calibrator**
- **New Sweep Amplifier**
- **New Sweep Magnifier**
- **New Direct-Coupled Unblanking**

With its many important new characteristics the Type 514-AD comes even closer to providing everything you need in a general-purpose laboratory oscilloscope. Excellent transient response, 10 mc bandwidth, 6 cm undistorted vertical deflection, and wide time base range increase the depth of investigation possible with this versatile new instrument. High quality design and construction assure long, trouble-free service.

Condensed Specifications

Vertical Amplifier
Risetime—0.04 μsec
Bandwidth—dc to 10 mc
ac—2 cycles to 10 mc
Sensitivity—dc, 0.3 v/cm to 100 v/cm
ac, 0.03 v/cm to 100 v/cm
Signal Delay—0.25 μsec
Calibrator—0 to 50 v square wave, accurate within 3%, duty cycle variable 2% to 98%

Time Base Range
0.1 μsec/cm to 0.01 sec/cm, continuously variable, accurate within 5%
Single, triggered, or recurrent sweeps
5x sweep magnifier
3 kv Accelerating Potential
All dc voltages electronically regulated

Type 514-AD—$950 • Type 514-A (without delay network) $900

Prices f.o.b. Portland, Oregon   *Write for complete specifications*

TEKTRONIX, Inc.
P. O. Box 831B, Portland 7, Oregon • Cable: TEKTRONIX

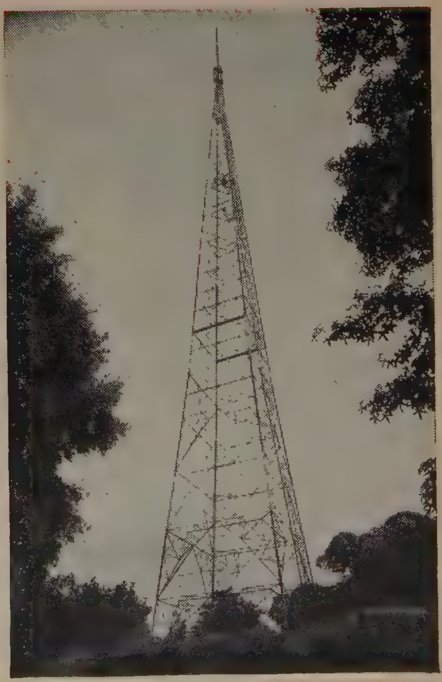
Regardless of conditions— BLAW-KNOX CAN BUILD YOU A *BETTER* TV TOWER

Years of experience—more than four decades, in fact—have given Blaw-Knox the edge in designing, fabricating and erecting antenna towers for any purpose and any location. Blaw-Knox TV towers are on the job in widely separated geographical areas . . . in wide open fields, atop buildings in crowded cities and even grounded in salt water. Some have TV antennas already mounted—others have built-in provisions for TV when licenses are granted—all are heavily galvanized for longer life.

Whether you need a 100 ft. self-supporting structure or a 1000 ft. guyed tower to meet your requirements—whether for AM, FM, TV or Microwave—write or call today for capable engineering assistance with your plans.

BLAW-KNOX

BLAW-KNOX COMPANY
BLAW-KNOX EQUIPMENT DIVISION
PITTSBURGH 22, PA.



COMMUNICATIONS SUPERVISORS:

get $25,000 coverage for $700!

Here are the plain facts that speak for themselves of $24,300 savings.

To increase the "talk-back" range of one-hundred cars from 20 miles to 25 miles—corresponding to an increase of 50% in area coverage—one-hundred 15 watt transmitters must be replaced with 60 watt transmitters . . . at an approximate cost of $25,000.

You can get the same coverage by installing an Andrew 3000-type antenna for only about $700.

One postcard can save you over $24,000. Before you buy, write us for a complete analysis of costs and antenna types to meet your needs.

Andrew
CORPORATION
363 East 75th Street • Chicago 19

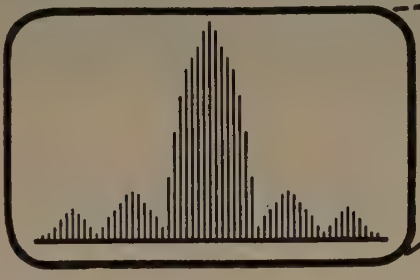
The FIRST and still the only

ALL-BAND DIRECT READING

SPECTRUM ANALYZER

10 MCS TO 21,000 MCS

Polarad's Model LSA Spectrum Analyzer is the result of years of research and development. It provides a simple and direct means of rapid and accurate measurement and spectral display of an r.f. signal.



- Continuous tuning.
- One tuning control.
- Resolution is 5KC when dispersion is 5MC per inch per sec.
- 250 KC to 25 MCS display at all frequencies.
- Tuning dial frequency accuracy 1%.
- No Klystron modes to set.
- Broadband attenuators supplied with equipment from 1 to 12 KMC.
- Frequency marker for measuring frequency differences 0-25 MCS.
- Only four tuning units required to cover entire range.
- Microwave components use latest design non-contacting shorts for long mechanical life.
- Maximum frequency coverage per dollar invested.
- 5 inch CRT display.

Where Used:

Model LSA Spectrum Analyzer is a laboratory instrument used to provide a visual indication of the frequency of distribution of energy in an r.f. signal in the range 10 to 21,000 MCS.

Other uses are:

1. Observe and measure sidebands associated with amplitude and frequency modulated signals.
2. Determine the presence and accurately measure the frequency of radio and/or radar signals.
3. Check the spectrum of magnetron oscillators.
4. Measures noise spectra.
5. Check and observe tracking of r.f. components of a radar system.
6. Check two r.f. signals differing by a small frequency separation.

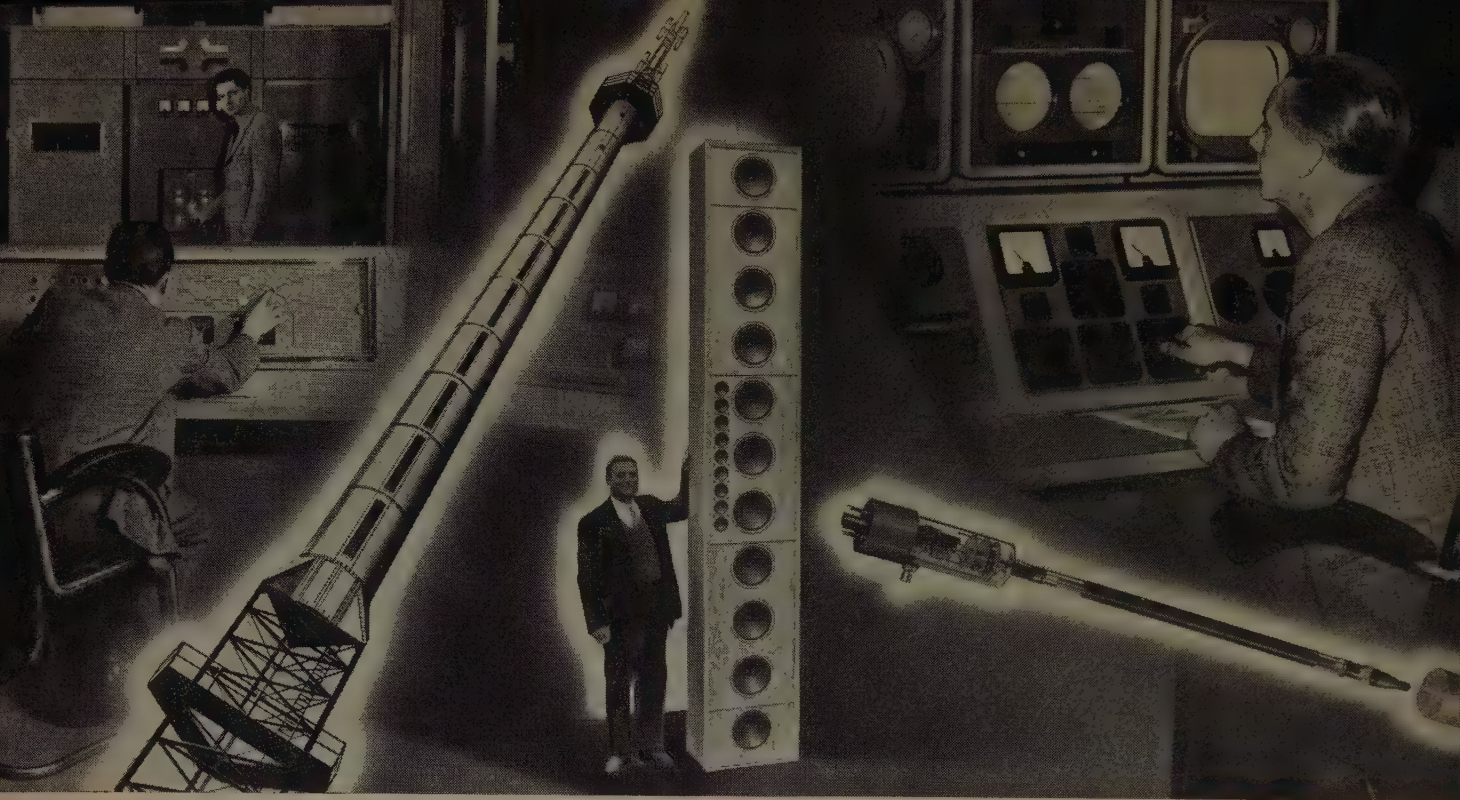
THE INSTRUMENT CONSISTS OF THE FOLLOWING UNITS:

Model LTU—1 RF Tuning Unit—10 to 1000 MCS.
Model LTU—2 RF Tuning Unit—940 to 4500 MCS.
Model LTU—3 RF Tuning Unit—4460 to 16,520 MCS.
Model LTU—4 RF Tuning Unit—15,000 to 21,000 MCS.
Model LDU—1 Spectrum Display Unit.
Model LPU—1 Power Unit.
Model LKU—1 Klystron Power Unit.

Write for Complete Details

Polarad
Electronics Corporation

100 METROPOLITAN AVE.
BROOKLYN 11, N. Y.
Export Dept.: 13 East 40 Street, New York 16, N. Y.
Cable Address: "ARLAB"



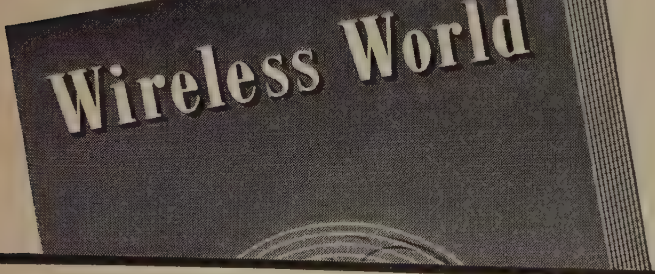
Up-to-date news of every British developmen

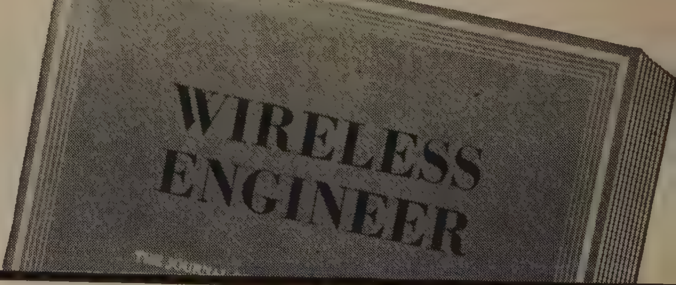
WIRELESS WORLD. Britain's chief technical magazine in the general field of radio, television and electronics. Founded over 40 years ago, it provides a complete and accurate survey of the newest British techniques in design and manufacture. Articles of a high standard cover every phase of radio and allied technical practice, with news items on the wider aspects of international radio. Theoretical articles by recognised experts deal with new developments, while design data and circuits for every application are published. WIRELESS WORLD is indispensable to technicians of all grades and is read in all parts of the world.

Published monthly, $4.50 *a year.*

WIRELESS ENGINEER — the magazine of radio researc and progress — is produced for research engineers, designer and students in the fields of radio, television and electronics Its editorial policy is to publish only original work, and it highly specialized content is accepted as the authoritativ source of information for advanced workers everywhere. Th magazine's Editorial Advisory Board contains representative of the National Physical Laboratory, the British Broadcastin Corporation, and the British Post Office. Regular feature include an Abstracts and References Section compiled by th Radio Research Organisation of the Department of Scientifi and Industrial Research.

Published monthly, $7.00 *a year*





MAIL THIS ORDER TODAY

To ILIFFE & SONS LIMITED, DORSET HOUSE, STAMFORD STREET, LONDON, S.E.1, ENGLAND

Please forward .... for 12 months. Payment is being made*

NAME ....

ADDRESS ....

CITY .... ZONE .... STATE ....

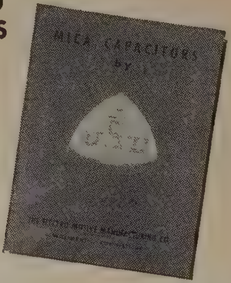
**Payment can be made by Bankers' Draft or International Money Order.*

ALL fixed mica El-Menco Capacitors are *factory-tested at double their working voltage.* Yet, you pay no premium for their superior performance. Meeting all significant specifications of JAN-C-5, they are being used in more and more military and civilian electronic applications.

Type CM-15, our tiny silvered mica capacitors, includes capacities from 2 to 420 mmf. at 500vDCw — 2 to 500 mmf. at 300 vDCw. Our other types — silvered and regular — offer ranges up to 10,000 mmf. Why not test them? *The Electro Motive Manufacturing Co., Inc., Willimantic, Conn.*

Jobbers and distributors are requested to write for information to Arco Electronics, Inc., 103 Lafayette St., New York, N. Y. — Sole Agent for Jobbers and Distributors in U. S. and Canada.

WRITE FOR FREE SAMPLES AND CATALOG ON YOUR FIRM'S LETTERHEAD



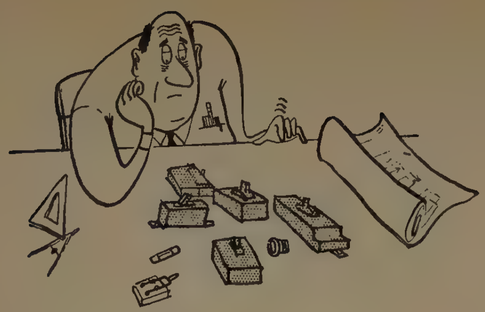
El-Menco

MOLDED MICA **MICA TRIMMER**

CAPACITORS

Foreign and Electronic Manufacturers Get Information Direct from our Export Dept. at Willimantic, Conn.

THE ELECTRO MOTIVE MFG. CO., INC. **WILLIMANTIC, CONNECTICUT**



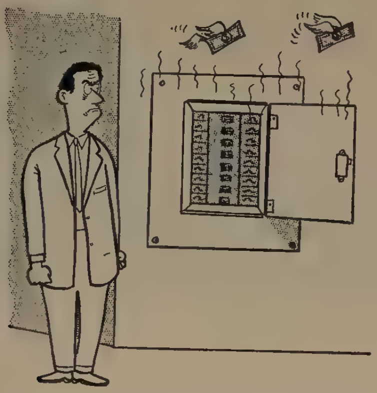
CIRCUIT PROTECTION . . .
so, what's the difference

There are many types of circuit protection devices on the market. Many of them are listed by Underwriters Laboratories since they pass certain safety test requirements.

Then, what makes HEINEMANN Circuit Breakers different? The difference is the HEINEMANN hydraulic-magnetic operating principle . . . eliminating thermal elements. Thus, you are assured instantaneous protection where you need it most . . . even on the small-sized shorts in lamp and appliance cords.

ALMOST HUMAN

With built-in time delay, HEINEMANN Circuit Breakers are almost human in their ability to differentiate between harmless and dangerous overloads. Delay is inversely proportioned . . . longer for small overloads; shorter for large ones. Time vs. per cent overload response curves may be selected to match the equipment or circuit requiring protection. *At ten times rated current, HEINEMANN Circuit Breakers always trip instantly* . . . providing the fastest circuit interruption available.



HERE'S A HOT ONE
...at your expense

HEAT in panelboards is no joke. It's the sign of wattage loss . . . current consumed in the panelboard itself. It is also a constant needless expense that can be eliminated by specifying HEINEMANN Circuit Breakers.

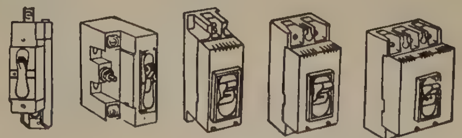
HEINEMANN Circuit Breakers *do not* generate any appreciable heat; wattage loss is negligible. They pay for themselves in power savings alone.

don't use heat . . . *USE POWER*

TWO OF OUR BEST CUSTOMERS

Eskimo Joe runs a little trading post up near Nome. Jungle George does a brisk business down in the Congo. Both buy lots of HEINEMANN Circuit Breakers to supply the folks thereabouts. Whether it's cold enough to freeze a polar bear in its tracks or hot enough to wilt an elephant's ear, HEINEMANN Circuit Breakers deliver the same consistently dependable protection. Their capacity is not affected by ambient temperature. You can locate them in the boiler room, kitchen or icebox. Summer or winter, in Florida or Maine . . . de-rating is never necessary . . . nuisance tripping never occurs.

EST. HECO 1888



Heinemann Circuit Breakers. One, two and three pole. 10 milliamps to 100 amperes.

HEINEMANN ELECTRIC CO.
154 PLUM STREET • TRENTON 2, N. J.

Send for your copy of Manual 101, entitled "What You Should Know About Circuit Breakers."

HEINEMANN Circuit Breakers

Here's up-to-the-minute data on 14 Centralab components

Electronic Engineers . . . write for these 14 new pictorial technical bulletins on important Centralab electronic developments

If you're one of the thousands of electronic engineers specifying Centralab electronic components — here's a quick way of bringing your file up-to-date. These 14 new bulletins . . . just off the press . . . are immediately available. Each contains essential, exact specifications for radio TV, UHF and VHF applications.

PRINTED ELECTRONIC CIRCUITS

1. AUDET, PC-150 & PC-151. Centralab's audio detector plate for a-c, d-c receiver output stages. Bulletin 42-129.

2. PENDET, PC-160. Remarkably small PEC consisting of 4 resistors and 5 capacitors requiring only 9 connections, instead of the usual 18. Bulletin 42-149.

3. MODEL 2 AMPEC, PC-200 & PC-201. A three-stage speech amplifier smaller than the cover of ordinary book matches. Bulletin 42-117R.

4. MODEL 3 AMPEC, PC-202 & PC-204. Postage-stamp size three-stage speech amplifier for sub-miniatures. Bulletin 42-130R.

5. PENTRODE COUPLATES, PC-90 & PC-91. Even smaller than before. A complete pentode inter-stage coupling circuit. Bulletin 42-128R.

6. TRIODE COUPLATES, PC-70, PC-71, PC-80, PC-81, for inter-stage audio coupling circuits. New space-saving design. Bulletin 42-127R.

7. SMALL PLATE COMPONENTS. Tiny resistor-capacitor combinations. Seven plates, including famous "Filpec," fit scores of miniature applications. Bulletin 42-132.

VARIABLE RESISTORS

8. MODEL 1 RADIOHMS (R) Smallest variable resistor on the market (only ⅝" dia.). Includes data on new Hi-Torque model. Bulletin 42-158.

9. MODEL 2 EXPRESS RADIOHM. Quick-delivery, switch-type variable resistor. Shafts staked directly to radiohm on your order. Bulletin 42-163.

CAPACITORS

10. TYPE 950 HIGH-ACCURACY. For exacting electronic applications in r.f. circuits. Bulletin 42-123.

11. BUTTON-TYPE CERAMIC CAPACITORS. Five different types, solder-sealed for HF, UHF, VHF applications. Bulletin 42-122R.

12. STAND-OFF. Designed especially for by-passing r.f. circuits to ground in low-power applications. Bulletin 42-121R.

13. TRANSMITTING. For transmitters, other high-voltage portable gear. Extremely compact and rugged. Bulletin 42-102R.

14. BC TUBULARS. New data on dependable BC-HI-KAPS, long preferred for by-pass coupling. Bulletin 42-3R.

You can depend on Centralab electronic components to maintain the high perfection and performance expected of modern electronic gear. By having full information at your fingertips, you can be sure of keeping abreast of the fast-changing electronics field. For your convenience, we've included a handy coupon.

Centralab
CRL
A Division of Globe-Union Inc.
Milwaukee 1, Wisconsin
In Canada, 635 Queen Street East, Toronto, Ontario

CENTRALAB, A Division of Globe-Union Inc.
920-F E. Keefe Ave., Milwaukee 1, Wisconsin

"Just check the items you want and we'll see that you get them by return mail."

☐ 42-129 ☐ 42-149 ☐ 42-117R ☐ 42-130R ☐ 42-128R ☐ 42-127R ☐ 42-132
☐ 42-158 ☐ 42-163 ☐ 42-123 ☐ 42-122R ☐ 42-102R ☐ 42-121R ☐ 42-3R

Name..
Company..
Title..
Address..
City........................Zone............State............

New flat-face, for easier, more accurate hand-tracing of waveforms

New high-brilliance fluorescent spot. You "see" more—even in work with high-speed phenomena

Higher sensitivity for vertical deflection. Ideal for wide-band amplifier work

FLAT-FACED

—for modern Oscillography!

3 new RCA 5" oscillograph tubes feature very high sensitivity and fine trace detail

You are looking at three new RCA tubes *designed specifically for work with wide-band amplifiers.* ● High vertical-deflection sensitivity offsets the inherently low-signal output of such amplifiers. ● Low-capacitance vertical-deflection electrodes offer the type of load into which wide-band amplifiers work best. ● High horizontal-deflection sensitivity, plus full-screen scan. ● New high-brilliance pin-point spot produces finer trace detail. ● And note this: *The flat faceplate makes it easier to "hand-trace" waveforms ACCURATELY!*

RCA-5ABP1 (medium-persistence) is ideal for wide-band vertical amplifier measurements—and for general oscillographic work requiring high-intensity tracing. RCA-5ABP7 (long-persistence) is suited to applications where No. 1 grid is pulse-modulated at low frequency—as in radar indicator services. RCA-5ABP11 (short-persistence) is especially designed for photographic recording without blurring.

For improved oscillograph tube performance, consider the advantages of the 5AB-types. These tubes generally can be substituted for the corresponding 5C-type. For technical data write RCA Commercial Engineering, Dept. 47FR, Harrison, N.J. Or write your nearest Field Office:

(East) Humboldt 5-3900, 415 S. 5th St., Harrison, N. J.
(Midwest) Whitehall 4-2900, 589 E. Illinois St., Chicago, Ill.
(West) Madison 9-3671, 420 S. San Pedro St., Los Angeles, Cal.

RADIO CORPORATION of AMERICA
ELECTRON TUBES
HARRISON, N. J.

4 mmf/ft

AIR-SPACED ARTICULATED
CO-AX
CABLES

offer a unique combination of

- ✓ FRACTIONAL CAPACITANCE
- ✓ HIGH IMPEDANCE
- ✓ MINIMUM ATTENUATION

ALONG WITH

- ✓ EXCEPTIONAL FLEXIBILITY
- ✓ LIGHT WEIGHT

38 STOCK TYPES

FOR ANY OF YOUR STANDARD OR SPECIAL APPLICATIONS

A few of the very low capacitance types are:

Type No.	*Capacitance* $\mu\mu$ *F/ft.*	*Impedance ohms*	*O.D.*
C.44	4.1	252	1.03″
C.4	4.6	229	1.03″
C.33	4.8	220	0.64″
C.3	5.4	197	0.64″
C.22	5.5	184	0.44″
C.2	6.3	171	0.44″
C.11	6.3	173	0.36″
C.1	7.3	150	0.36″

WE ARE SPECIALLY ORGANIZED TO HANDLE DIRECT ORDERS OR ENQUIRIES FROM OVERSEAS

SPOT DELIVERIES FOR U.S.

BILLED IN DOLLARS—SETTLEMENT BY YOUR CHECK

CABLE OR AIRMAIL TODAY

TRANSRADIO LTD.

CONTRACTORS TO
H.M. GOVERNMENT

138A CROMWELL RD., LONDON, S.W.7
ENGLAND

CABLES: TRANSRAD LONDON

Meet the Redheads...
tops for tape recording

See how the latest additions to the Brush family of magnetic recording components can improve your tape recorders!

The BK-1090 record-reproduce head has the standard track width designed for dual track recording on ¼ inch tape. It provides unusually high resolution and uniformity over an extended frequency range. Cast resin construction assures dimensional stability, minimizes moisture absorption, and affords freedom from microphonics. Its balanced magnetic construction, precision lapped gap, Mu-metal housing, and single-hole mounting provide important design advantages.

The BK-1110 erase head has the same basic construction as the companion record-reproduce unit. Its outstanding feature is its efficient erasing at low power consumption—less than ½ voltampere.

Investigate these new "Redheads" for your magnetic recording. Your inquiries will receive the attention of capable engineers. Write Brush Electronics Company, Department F-6, 3405 Perkins Avenue, Cleveland 14, Ohio.

BRUSH ELECTRONICS BRUSH ELECTRONICS **COMPANY**

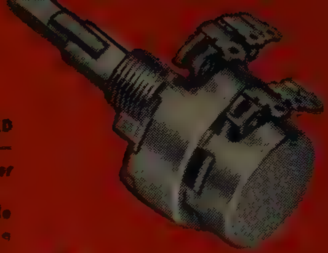
INDUSTRIAL AND RESEARCH INSTRUMENTS
PIEZOELECTRIC MATERIALS • ACOUSTIC DEVICES
MAGNETIC RECORDING EQUIPMENT
ULTRASONIC EQUIPMENT

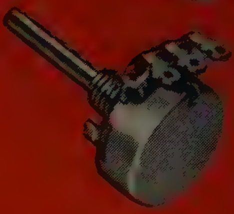
formerly
The Brush Development Co.
Brush Electronics Company
is an operating unit of
Clevite Corporation.

COMPLETE CIVILIAN LINE

Exceptionally good delivery cycle on civilian orders due to tremendous mass production facilities.

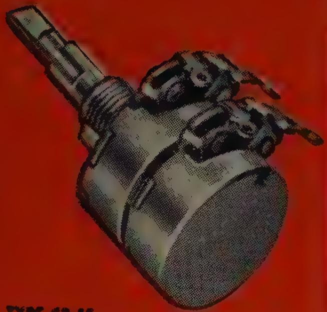
TYPE C45-70





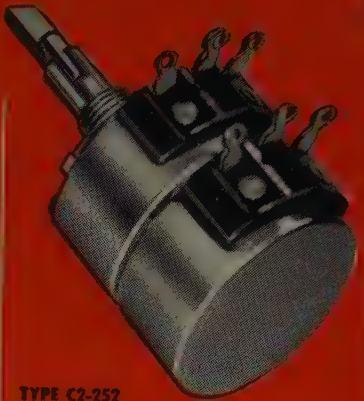
NEW HIGH QUALITY MINIATURIZED "DIME-SIZE" CIVILIAN CONTROL—*Performance Fully Equals Larger Types.*

TYPE 70, 3/4" diameter variable composition resister. Wattage rating: .3 watt for resistances through 10,000 ohms, .2 watt with 350 volts maximum across end terminals for resistances over 10,000 ohms. Also available in concentric shaft tandem construction C45-70 as shown above.

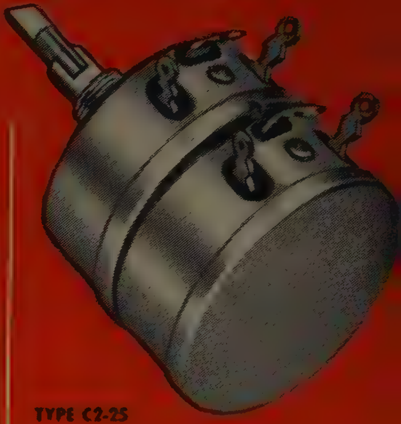


TYPE C2-45

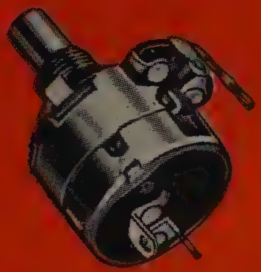
TYPE C2-35



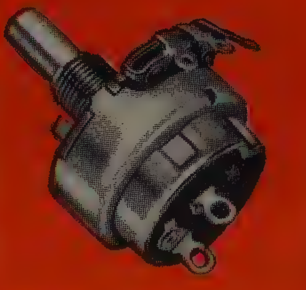
TYPE C2-252



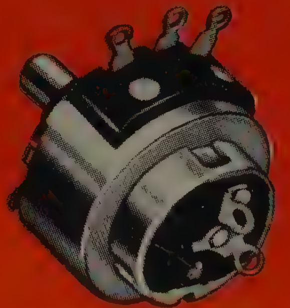
TYPE C2-25



TYPE GC-45, 15/16" diameter variable composition resistor. Wattage rating: 1/2 watt for resistances through 10,000 ohms, 1/3 watt for resistances over 10,000 ohms through 100,000 ohms, 1/4 watt with 500 volts maximum across end terminals for resistances over 100,000 ohms. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-45 as shown above.



TYPE GC-35, 1 1/8" diameter variable composition resistor. Wattage rating: 3/4 watt for resistances through 10,000 ohms, 2/3 watt for resistances over 10,000 ohms through 25,000 ohms, 1/2 watt with 500 volts maximum across end terminals for resistances over 25,000 ohms. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-35 as shown above.



TYPE GC-252, 2 watt, 1 17/64" diameter variable wirewound resistor. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-252 as shown above.

TYPE GC-25, 4 watt, 1 17/32" diameter variable wirewound resistor. Available with or without illustrated attached switch and in concentric shaft tandem construction C2-25 as shown above.

Typical concentric shaft tandem with panel and rear sections operating separately from concentric shafts (TYPE C45-70 ILLUSTRATED). Similar construction available for all military resistors.

REPRESENTATIVES

Henry E. Sanders
McClatchy Bldg.
69th & Market St.
Upper Darby, Penna.
Phone: Flanders 2-4420

W. S. Harmon Company
1638 So. La Cienega Blvd.
Los Angeles 35, California
Phone: Bradshaw 2-3321

John A. Green Company
6815 Oriole Drive
Dallas 9, Texas

IN CANADA

C. C. Meredith & Co.
Streetsville, Ontario

SOUTH AMERICA

Jose Luis Pontet
Buenos Aires, Argentina
Montevideo, Uruguay
Rio de Janeiro, Brazil
Sao Paulo, Brazil

OTHER EXPORT

Sylvan Ginsbury
8 West 40th Street
New York 18, N. Y.

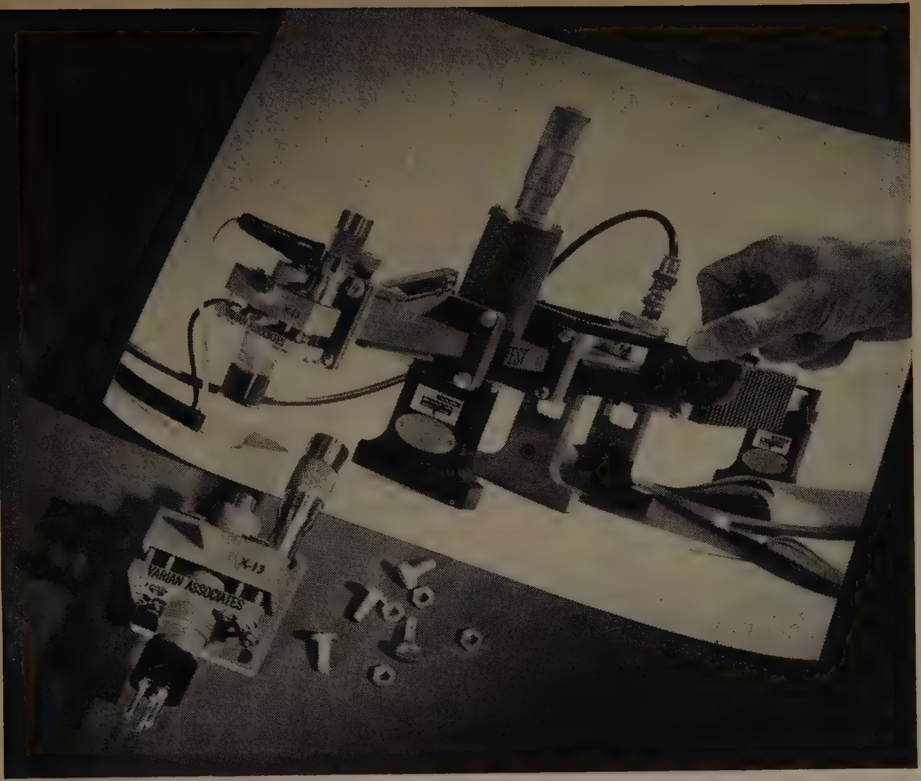
VARIAN *associates

VERSATILE X-BAND SIGNAL SOURCE

Varian X-13 reflex klystron

. . . 8.2-12.4 kmc

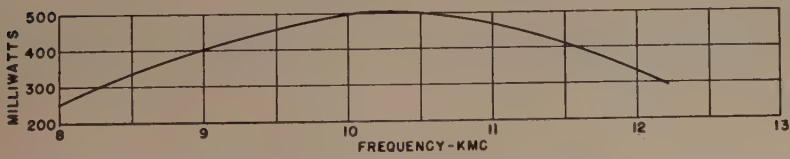
. . . 150-500 mw



IN LABORATORIES throughout the electronic field, the Varian X-13 Klystron is widely used as a general-purpose x-band signal source. In the typical setup above (checking load reflection), note the compactness, the convenience of connection, and the way the tube bolts directly to the waveguide.

OUTPUT POWER typically reaches half a watt at center frequency and exceeds 150 milliwatts over the full frequency range 8.2 to 12.4 kmc. The X-13 exhibits extremely low microphonic levels and operates directly into matched waveguide. Tuning is done with a single control. The tube is air cooled and has clearance dimensions of 4½ by 2½ by 2½ in., weight of only 6 oz.

Typical Power Output - Varian X-13 Klystron
(Beam Voltage, 500 v)



OTHER VARIAN KLYSTRONS extend and expand the functions of the X-13. An extensive line of tubes with designs based on that of the X-13 offers a wide selection of output powers, types of tuning devices and terminations, as well as capabilities for withstanding vibration and shock ranging far beyond 30 times gravity.

SEND FOR DATA on these or other klystrons from the extensive Varian line, many of which are necessarily unpublicized. You are invited to submit your microwave problems to the Varian application-engineering group for recommendations.

* Trade Mark

VARIAN associates
990 VARIAN STREET • SAN CARLOS 2, CALIFORNIA

FIELD ENGINEERING REPRESENTATIVES IN PRINCIPAL CITIES

Something New Has Been Added!

The 21 IRE Professional Groups show the expansion pattern of a modern engineering society in meeting the diversified needs of its members in the ever widening science of radio-electronics.

Membership in a Professional Group is open to any paid-up member of the I.R.E. The cost is only an annual extra publications fee, usually $2. This fee is shown in the descriptions that follow.

An IRE Member may join as many Professional Groups as serve his interest and wishes. Such membership serves to associate him with other engineers of the same specialized interests within the radio-electronic field.

The 21 Professional Groups are listed below, together with a brief definition of each, the name of the Group Chairman, and publications to date. * Means still available. ** Expected by June 10, 1953.

Airborne Electronics

The application of electronics to operation and traffic control of aircraft and to navigation of all craft.

Dr. K. Charlton Black, Chairman, Polytechnic Research & Development Co., 55 Johnson Street, Brooklyn 1, N.Y.

Fee $2. 7 Transactions, 4 Newsletters *4, 5, & 6, and Newsletters.

Antennas and Propagation

Technical advances in antennas and wave propagation theory and the utilization of techniques or products of this field.

Mr. P. S. Carter, Chairman, c/o RCA Laboratories, Rocky Point, L.I., N.Y.

Fee $4. Four transactions published. *4

Audio

Technology of communication at audio frequencies and of the audio portion of radio frequency systems, including acoustic terminations, recording and reproduction.

Mr. Marvin Camras, Chairman, Armour Research Foundation Chicago, Ill.

Fee $2. Published 12 Transactions, 4 Newsletters. *5, 6, 9 up.

Broadcast & Television Receivers

The design and manufacture of broadcast and television receivers and components and activities related thereto.

Mr. Dorman D. Isreal, Chairman, Emerson Radio and Phonograph Corp., 111 Eighth Avenue, New York 11, N.Y.

Fee $2. Transactions *1, *2, **3

Broadcast Transmission Systems

Broadcast transmission systems engineering, including the design and utilization of broadcast equipment.

Mr. Lewis Winner, Chairman, 52 Vanderbilt Avenue, New York 17, N.Y.

Fee $2. **Convention Report.

Circuit Theory

Design and theory of operation of circuits for use in radio and electronic equipment.

Mr. Robert L. Dietzold, Chairman, Reactor Development Div. U. S. Atomic Energy Commission, 1901 Constitution Ave., Rm. 132, Washington, D.C.

Fee $2. *PGTC-1 Transaction.

THE INSTITUTE OF RADIO

CLIMATE-PROOF PACKAGING

CARGO

Here's a quick solution to

MILITARY PACKAGING

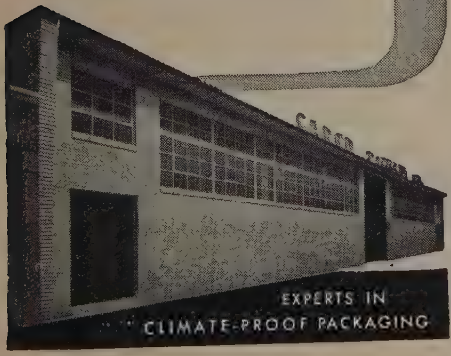
CARGO PACKERS CLIMATE-PROOF PACKAGING

Meets all Specifications for Signal Corps, Navy and Air Force Shipments of Electronic Equipment with Facilities that include—

- SPECIAL PACKAGING EQUIPMENT
- EXPERTS IN MILITARY SPECIFICATIONS
- ECONOMICAL ASSEMBLY LINE METHODS
- FULL COMPLIANCE IN EVERY DETAIL
- COMPETENT CONSULTING SERVICE

NEW ILLUSTRATED BROCHURE explains in detail how Cargo Packers can economically handle all details of your military packaging problems. You save valuable plant space, costly equipment and the need for experienced specification packaging experts. Find out now, how Cargo Packers production line methods save you time, money, endless detail work, and costly errors. Request your copy, now!

CARGO PACKERS
INCORPORATED
73 RUTLEDGE STREET
BROOKLYN 11, NEW YORK



---

get 3-way utility with the BERKELEY model 5500

universal Counter & Timer

for laboratory or production line, the versatile, direct-reading Model 5500 provides, in one compact instrument, facilities for faster, easier and more accurate:

1. TIME INTERVAL MEASUREMENT, with a range of 40 microseconds to 100,000 seconds, with a possible accuracy of ± 10 microseconds.

2. EVENTS-PER-UNIT-TIME DETERMINATION with selectable time base of .0001, .001, .01, .1, 1 and 10 seconds. Counting range is 20 to 100,000 cps; accuracy ± 1 count.

3. STRAIGHTFORWARD COUNTING at rates to 100,000 cps with absolute accuracy.

applications:

Relay and Switch Timing
Viscosity Measurements
Timing of Photographic Components
Ballistic Measurements
Elasticity Measurements
Accurate Low Frequency Measurements
Tachometry
Frequency Characteristic Measurements
Frequency Ratio Measurements
Secondary Frequency Standard
Telemetering

—and many more. Our engineering staff will gladly assist in adapting this versatile instrument to your special needs.

features:

DIRECT-READING decimal presentation of information reduces operator fatigue, minimizes error. No interpolation required.

AUTOMATIC OPERATIONAL CHECK can be made in two seconds.

PRINTED READOUT available for permanently recording data on standard adding machine tape.

BRIEF SPECIFICATIONS

	Frequency Counting	Time Interval Measurement	Period Measurement
• Range:	20 cps to 100 kc	40 μs to 100,000 sec.	0 cps to 10 kc
• Accuracy:	± 1 count (1 sec.) ± .0001% (10 sec.)	± 10 μs	± 10 μs
• Input Sensitivity:	0.2 to 20 v. RMS	1 v. peak with 1 v. per μs rise time	0.2 v. peak, d. c.
• Gate Time (or freq.):	.0001, .001, .01, .1, 1 and 10 sec.	100, 10, 1 kc, 100, 10, 1 cps	1 or 10 cycles of input signal
• Crystal Stability:	1 part in 10^6 (temp. controlled)		
• Power Requirements:	117 v., ± 10%, 50-60 cycles, 200 watts		
• Accessory Socket Connections:	External reset; ± 100 v., 5 ma; + 290 v., 25 ma; 6.3 v. a.c., 2 amps; ground		
• Display Time:	Continuously variable from .5 to 5 seconds		
• Dimensions, Weight:	20¾" wide x 12" high x 15" deep; 84 lbs.		
• Price:	$980.00, f.o.b. Richmond, Calif.		

✱ For complete data, please request Bulletin 206

Berkeley division
BECKMAN INSTRUMENTS INC.
2200 WRIGHT AVE., RICHMOND, CALIF.

M-11

Engineers & Physicists

- Mechanical Engineers
- Servo Engineers
- Operations Research Analysts
- Electrical Engineers
- Chemical Engineers
- Physicists

The diversified research and development programs now in progress at

melpar, inc.

The Research Laboratory

of Westinghouse Air Brake Co. and its subsidiaries

offer excellent opportunities for professional achievement to qualified men.

Write to Personnel Director,

MELPAR, INC.

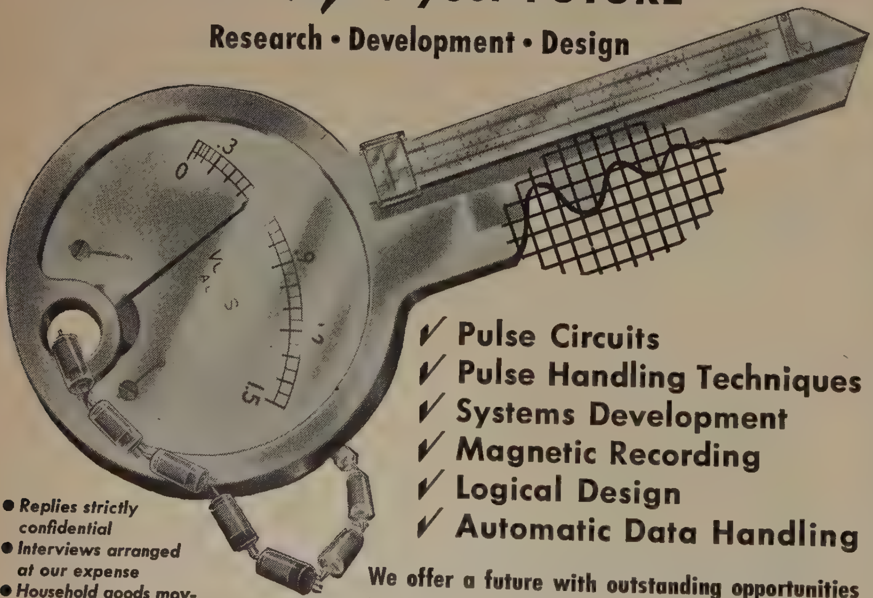
452 Swann Avenue

Alexandria, Virginia

DIGITAL COMPUTER ENGINEERS

...the Key to your FUTURE

Research • Development • Design



✓ Pulse Circuits
✓ Pulse Handling Techniques
✓ Systems Development
✓ Magnetic Recording
✓ Logical Design
✓ Automatic Data Handling

- *Replies strictly confidential*
- *Interviews arranged at our expense*
- *Household goods moving expenses paid*

We offer a future with outstanding opportunities to engineers with ability in the above fields.

Engineering Research Associates | Division of *Remington Rand INC*

1902 W. Minnehaha Ave. • St. Paul W4, Minnesota

You will enjoy LIVING in Minnesota

POSITIONS OPEN

The following positions of interest to I.R.E. members have been reported as open. Apply in writing, addressing reply to company mentioned or to Box No. ....

The Institute reserves the right to refuse any announcement without giving a reason for the refusal.

PROCEEDINGS of the I.R.E.
1 East 79th St., New York 21, N.Y.

ENGINEER PHYSICIST

A new Florida firm has an opening for an engineer or physicist with at least 2 years experience for development work on application of radioactive batteries. Some ordnance experience preferable but not required. Address: Radiation Research Corp., Box 8126, West Palm Beach, Fla.

CIRCUIT ENGINEERS

Electronic engineers are required for development in the field of color and monochrome television, UHF, and transistor applications. Needed are Senior and Intermediate engineers to direct projects, also Junior engineers. Work is in a well equipped laboratory in mid-town New York City. Liberal employee benefits, security and opportunity to advance. Salary commensurate with education and training. Send resume or call in person at RCA Laboratories, 711 Fifth Ave., New York 22, N.Y.

(Continued on page 132A)

ELECTRONIC ENGINEERS

FOR DESIGN AND DEVELOPMENT WORK IN

RADAR

COMPUTERS

TELEMETERING

DATA REDUCTION

SERVO MECHANISMS

DIGITAL TECHNIQUES

A CHANCE TO GROW WITH A YOUNG PROGRESSIVE COMPANY, SALARIES AND ADVANCEMENT COMMENSURATE WITH ABILITY, LIBERAL VACATIONS, SICK LEAVE, EIGHT PAID HOLIDAYS, GROUP INSURANCE, EDUCATIONAL ASSISTANCE PROGRAM, EXCELLENT WORKING CONDITIONS. SEND RESUME OF EXPERIENCE AND EDUCATION WITH SALARY REQUIREMENTS AND AVAILABILITY DATE TO:

Electronic Engineering Company
of California
180 SOUTH ALVARADO STREET
LOS ANGELES • 4 • CALIFORNIA

A QUESTION FOR ALL ENGINEERS:

Q: *Where will you be 10 years from now?*

A:

Will *your* achievements be recognized? Will *you* be associated with distinguished scientists and engineers? Will *your* work provide a challenge for *your* talent and ability? Will *your* position and income be founded upon *your* real merit?

At RCA, you'll find plenty of "future insurance" . . . and right now is the time to investigate RCA opportunities. Because RCA is now looking for experienced ELECTRONIC, COMPUTER, ELECTRICAL, MECHANICAL, and COMMUNICATIONS ENGINEERS . . . PHYSICISTS . . . METALLURGISTS . . . PHYSICAL CHEMISTS . . . CERAMISTS . . . GLASS TECHNOLOGISTS. Whichever your specialty, there's a chance of a lifetime for a career with RCA—world leader in electronic development, first in radio, first in recorded music, first in television. RCA growth has remained steady through war and depression . . . you'll find positions open today in many commercial projects, as well as military lines.

WHY RCA IS A *GOOD* PLACE FOR YOU TO WORK

Facilities for creative engineering are top-notch. Working conditions and associates stimulate you. Periodic merit reviews help you advance in grade and income. Your family can enjoy pleasant country or suburban living. RCA encourages growth of your professional status and recognition. Company-paid benefits—including life, accident and hospitalization insurance—increase your feeling of security. You look forward to retirement through a progressive program. RCA has a modern tuition refund plan for advanced study at recognized universities.

Positions Open In

RESEARCH—DEVELOPMENT—DESIGN—APPLICATION

in any of the following fields:

RADAR—Circuitry—Antenna Design—Servo Systems—Information Display Systems—Gear Trains—Stable Elements—Intricate Mechanisms

COMPUTERS—Digital and Analog—Systems Planning—Storage Technique—Circuitry—Servo Mechanisms—Assembly Design—High Speed Intricate Mechanisms

COMMUNICATIONS — Microwave — Aviation — Mobile—Specialized Military Systems

MISSILE GUIDANCE—Systems Planning and Design—Radar and Fire Control—Servo Mechanisms—Vibration and Shock Problems

NAVIGATIONAL AIDS— Loran — Shoran — Altimeters—Airborne Radar

TELEVISION DEVELOPMENT—Receivers—Transmitters and Studio Equipment

COMPONENT PARTS—Transformer—Coil—Relay—Capacitor—Switch—Motor—Resistor

ELECTRONIC TUBE DEVELOPMENT—Receiving—Transmitting—Cathode-Ray—Phototubes and Magnetrons

ELECTRONIC EQUIPMENT FIELD ENGINEERS — Specialists for domestic and overseas assignment on military electronic communications and detection gear.

Personal interviews arranged in your city.

Please send a complete resume of your education and experience to:

MR. ROBERT E. McQUISTON, Manager, Specialized Employment Division
Dept. 202-F, Radio Corporation of America, 30 Rockefeller Plaza, New York 20, N.Y.

RCA **RADIO CORPORATION of AMERICA**

"An Unexcelled Opportunity
For Professional Growth . . ."

Electronic
ENGINEERS & PHYSICISTS

IN RESEARCH AND DEVELOPMENT

Guided Missiles—Radar—Solid State Physics
Vacuum Tubes—Electronic Navigation—
Television—Microwaves—Antennas—
Radio—Computers—Transistors

Direct Inquiries to:

The Employment Dept.
CAPEHART-FARNSWORTH
CORPORATION
FORT WAYNE, INDIANA

AN IT&T ASSOCIATE

ELECTRONIC & MECHANICAL ENGINEERS

Well established Southern California TV and Special Apparatus Electronics manufacturer is expanding all operations and desires experienced engineering personnel at all levels of Advanced Development and Product Design in the following fields:

Transistors	UHF
Color	Mechanical
Radio	Audio

Applicants having at least a B.S. degree are requested to send resumes which will be held confidential. Those who qualify will receive prompt interviews. Salaries open.

HOFFMAN RADIO CORPORATION
6200 Avalon Blvd., Los Angeles, Calif.

ELECTRONICS ENGINEERS

Project • Design • Group • Field • Junior • Senior

AIRCRAFT ARMAMENTS' development engineering program in the fields of radar, fire control and associated equipment has provided more openings for men at all levels of experience.

If you are considering a change and are looking for a young, growing company with a continuing program of development work, we would appreciate receiving your resume and would welcome the opportunity of providing you with information about our company.

D. J. WISHART
Director of Personnel

AIRCRAFT ARMAMENTS INC.
4415-17 REISTERSTOWN ROAD
BALTIMORE 15, MD.

UHF
and
MICROWAVE
ENGINEERS

This rapidly growing organization in South Central Wisconsin, which is approximately 100 miles from Chicago, Ill., has several openings for Junior and Senior Engineers in the UHF and Microwave Field.

UNUSUAL SALARY OPPORTUNITIES

exist under ideal working conditions in large well equipped laboratories. Personnel benefits such as sickness, accident and life insurance in addition to a very liberal pension system are offered.

For more information concerning the positions that are open, we invite you to write to

Personnel Director, Dept. A.

GIBBS MANUFACTURING
& RESEARCH CORP.
Janesville, Wisconsin

ELECTRONIC
ENGINEER

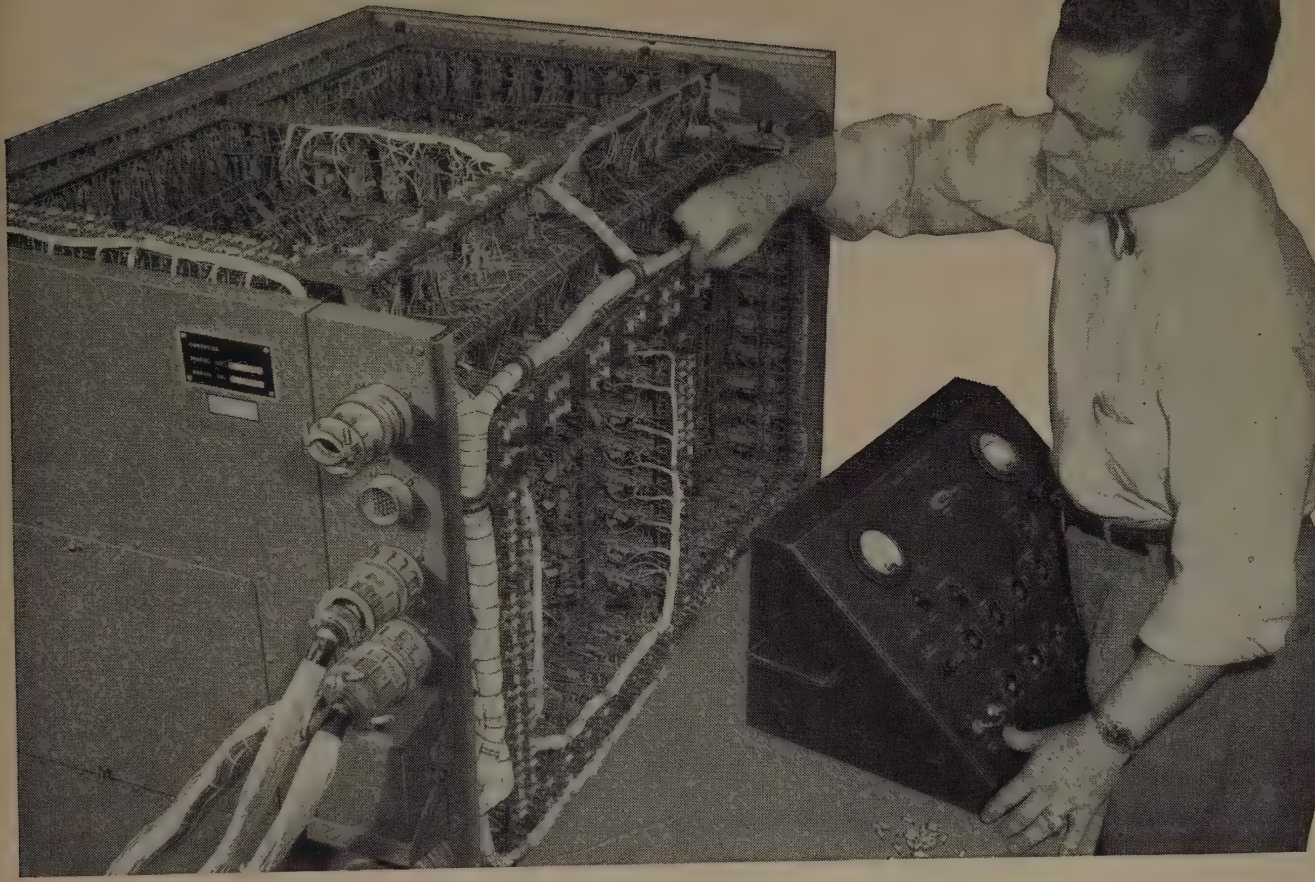
We are looking for a man with sound scientific training, preferably a Ph.D. degree, who combines imagination with good commercial judgment to join a small advance development group. He will be associated with physicists, physical chemists and mechanical engineers and will be called upon to present and evaluate ideas for development into commercial products. Mental flexibility and broad general interest will be important requisites. The person we are looking for must be capable of presenting his thoughts well either in reports or oral form.

Please send us a resume of your qualifications, experience and salary expected. Replies will be treated confidentially.

CLEVITE-BRUSH
DEVELOPMENT COMPANY
Division of Clevite Corporation
3311 Perkins Avenue
CLEVELAND, OHIO

Operating Units of Clevite Corp. are Cleveland Graphite Bronze Company, Brush Electronics Company (formerly Brush Development Company), Harris Products Company, Transistor Products, Inc.

ENGINEERING BRAINS TEAM
WITH ELECTRONIC BRAINS



AT NORTH AMERICAN AVIATION

The combination of North American's imaginative scientists and engineers working with lightning-fast electronic "thinking" machines is an unbeatable one . . . for together they've set advanced standards for guided missile research, development, and design.

Computers like the one being checked above are used to predetermine the flight pattern of a given missile design by simulating its flight conditions, and to solve related problems. North American Aviation engineers also develop and use other electro-mechanical computers which become the brains of automatic guidance systems for missiles and for fire and flight control equipment.

Development of guidance systems for long-range missiles is just one example of the challenging electronic and electro-mechanical work being pioneered in North American's Missile and Control Equipment Operations. If you like theory, you will find an exciting career at North American in specialties such as operations analysis, advanced dynamics, kinematics, noise, error and information theory, systems engineering, statistical quality control, servo analysis, and other advanced fields.

If research, development, or design is your specialty, you'll find attractive opportunities in automatic guidance systems, fire and flight control systems, radar and airborne communications systems and other system developments.

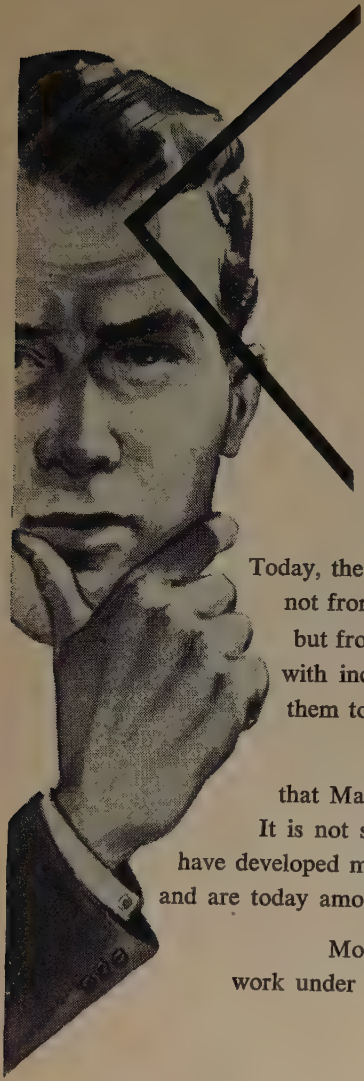
Write today for complete information, giving us your education and experience.

NORTH AMERICAN AVIATION, INC.

Engineering Personnel Section, Missile and Control Equipment Operations
12214 Lakewood Boulevard, Dept. 93-R, Downey, California

NORTH AMERICAN HAS BUILT MORE AIRPLANES THAN ANY OTHER COMPANY IN THE WORLD

ENGINEERS



where do great ideas come from?

Today, the great ideas that benefit mankind come . . . not from a struggling young genius in a garret . . . but from men who work in an environment rich with incentives, facilities and resources, enabling them to put their ideas into practical application.

This is the kind of working environment that Magnavox has always provided its engineers. It is not surprising, then, that Magnavox engineers have developed many of the "firsts" in radio and television and are today among the leaders in the electronics industry.

More than ever before, Magnavox engineers work under conditions conducive to creative thought. They constitute a completely self-contained, closely-knit organization devoted to engineering exclusively with all other services available to them.

Needless to say, job satisfaction at Magnavox is unusually high.

OPPORTUNITIES ARE GROUND FLOOR IN THE FIELDS OF:

Radar
Radio — Commercial and Military
Television — Monochrome and Color
Magnetic Amplifiers

Synchros — Servo Systems
Magnetic Devices
Electro-Mechanical Devices
Navigational Aids — Fire Control

DESIGN — DEVELOPMENT — CIRCUITRY

Electrical Engineers — Mechanical Engineers — Physicists

Please forward complete resume to:
MR. BYRON D. SITES

THE MAGNAVOX COMPANY
FORT WAYNE, INDIANA

Positions Open

(*Continued from page 128A*)

PHYSICISTS AND ENGINEERS

Southwest Research Institute has several permanent staff positions for physicists and engineers with B.S. or advanced degrees and 2 to 5 years experience in acoustics, H.F. and V.H.F. antenna design, electromechanical transducer research, optical instruments, and pulse circuits. Send statement of qualifications and interests in industrial and defense research to: Physics Dept., Southwest Research Institute, 8500 Culebra Rd., San Antonio, Tex.

QUARTZ CRYSTALS ENGINEERS

World's largest producer of crystals needs additional Project Engineers. Applicants should have a working knowledge of crystal manufacturing. Send complete resume, with age, education, experience, salary desired. Midland Manufacturing Co., 3155 Fiberglass Rd., Kansas City 15, Kan.

PHYSICISTS

Physicists for acoustics research and development—research and development work in transducer design, directionalty problems, underwater sound characteristics, sound transmission and attenuation problems and noise reduction problems. Requires M.S. or Ph.D. in physics. Opportunities for graduation work. Salary open. Send personal data to: Arnold Addison, Personnel Director, Ordnance Research Laboratory, Box 30, State College, Pa.

TRANSFORMER ENGINEER

Transformer engineer with experience in design and development of transformers for electronic applications, and capable of assuming the position as head of a design section on this type of equipment. All replies will be confidential and should include details of education, experience and salary desired. Box 726.

(*Continued on page 138A*)

ELECTRON TUBE TECHNICIANS

We now have several openings for technicians to work in the fabrication and processing of advanced type electron tube research models.

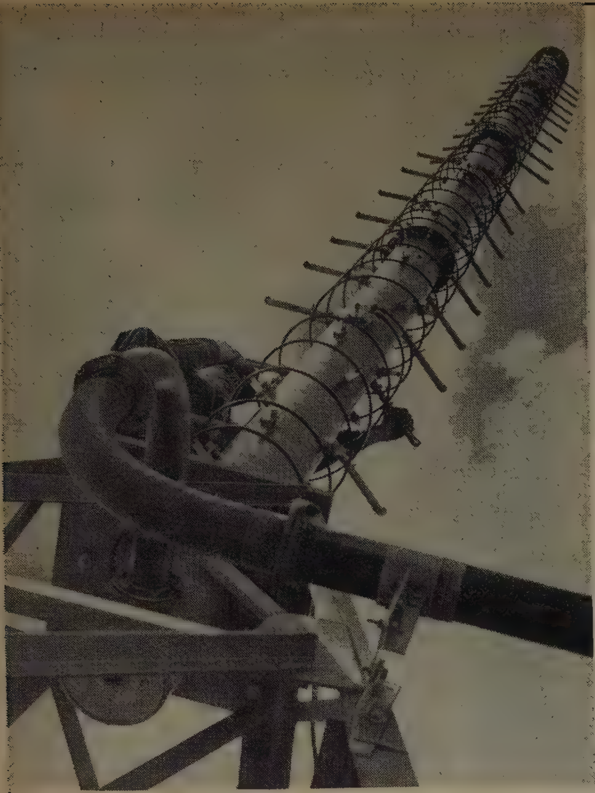
To qualify for one of these openings you should be experienced in experimental work for research and development in vacuum tubes, which includes the fields of mechanics, electronics, chemistry and high-vacuum techniques.

ADDRESS RESUME OF TRAINING AND EXPERIENCE TO

HUGHES
RESEARCH AND DEVELOPMENT LABORATORIES

Technical Personnel Department

CULVER CITY,
LOS ANGELES COUNTY,
CALIFORNIA



Typical of General Electric's pace-setting developments — this new type of television transmitting antenna that increases by 25 times the effective radiated power of the UHF station transmitter.

NEW DEVELOPMENTS BY GENERAL ELECTRIC ENGINEERS SHOW VERSATILITY OF ELECTRONICS

Again and again, General Electric engineers have pioneered the new developments in electronics.

This is no coincidence, for a number of important factors have made these achievements possible: the vast facilities provided by General Electric; the opportunity to apply the most creative thinking to challenging problems; the stimulating association with outstanding men in the profession; the strong sense of stability inherent in a General Electric job.

The same opportunities are open to engineers, physicists, chemists and metallurgists in the following fields: Advanced Development, Design, Field Service and Technical Writing in connection with:

MILITARY RADIO & RADAR
MOBILE COMMUNICATION
MULTIPLEX MICROWAVE
COMMUNICATIONS
ELECTRONIC COMPONENTS
TELEVISION, TUBES & ANTENNAS.

Bachelor's or advanced degrees in Electrical or Mechanical Engineering, Physics, Metallurgy or Physical Chemistry and/or experience in electronics industry necessary.

Please send resume to:

GENERAL ELECTRIC

Dept. 6-3-P, Technical Personnel
ELECTRONICS PARK Syracuse, N. Y.

ENGINEERS PHYSICISTS

TAKE INVENTORY OF YOUR FUTURE

WHAT MAKES A GOOD JOB?

Check off the items in the following list that you look for in a good job.

1—Professional Recognition
2—Interesting work
3—Equitable salary
4—Recognition of Ability
5—Security
6—Good future prospects
7—Reward for ideas
8—Good working conditions
9—Liberal benefit program
10—Family protection
11—Paid vacations and holidays

If you look for all of the above items and more, in a good job, it will be to your advantage to investigate the opportunities in Electronic Circuit Design and Specialized vacuum tube research and development at . . .

NATIONAL UNION RADIO CORP.
ELECTRONIC RESEARCH DIVISION
P. O. Box 352 Orange, New Jersey

EXPERIENCED RADAR AND COMPUTER ENGINEERS

in one or more of the following fields:

- General radar and computing systems
- Servomechanisms
- Radar transmitter-modulators
- Generalized systems analysis
- Indicator systems
- Wide band I F amplifiers and receivers
- General pulse circuits
- Electro-mechanical design

UNUSUAL OPPORTUNITIES IN LONG-TERM DEVELOPMENT OF RADAR AND RELATED EQUIPMENT

SINCE 1912 A LEADER IN RESEARCH DEVELOPMENT AND PRODUCTION

Gilfillan Bros., Inc.

1815 Venice Blvd., Los Angeles 6, California
BROCHURE ON REQUEST

ENGINEERS

USE YOUR EXPERIENCE TO BUILD A SOUND FUTURE AT SPERRY

Choose your desired field of work! Project and product engineering work exists for graduate engineers with design, development and product experience in:

VACUUM TUBE TECHNIQUES • ANALOGUE COMPUTERS • RADAR • HYDRAULICS • COMMUNICATION EQUIPMENT • ELECTRONIC PACKAGING • PULSE TRANSFORMERS • SERVO MECHANISMS • ELECTRONIC CIRCUITS • AIRCRAFT CONTROLS • INSTRUMENTATION • PRINTED CIRCUITS • FRACTIONAL H.P. MOTORS • MAGNETIC AMPLIFIERS • RADIO FREQUENCY & MICROWAVE MEASUREMENT

ALSO PUBLICATIONS ENGINEERS To write manuals and engineering reports.

ENJOY MANY ADVANTAGES

• Interesting, diversified work plus • Association with top engineering men on unusual engineering problems • Cost of Living Adjustment • Adequate Housing • Liberal Employee Benefits • Top Rates

SUBMIT RESUME TO EMPLOYMENT OFFICE

SPERRY GYROSCOPE CO.
DIVISION OF THE SPERRY CORP. **GREAT NECK, L. I., N.Y.**

ELECTRONIC ENGINEERS WANTED SOUTHERN CALIFORNIA

Attractive opportunities offered to Engineers experienced in and qualified to design aircraft flush antennas and radomes.

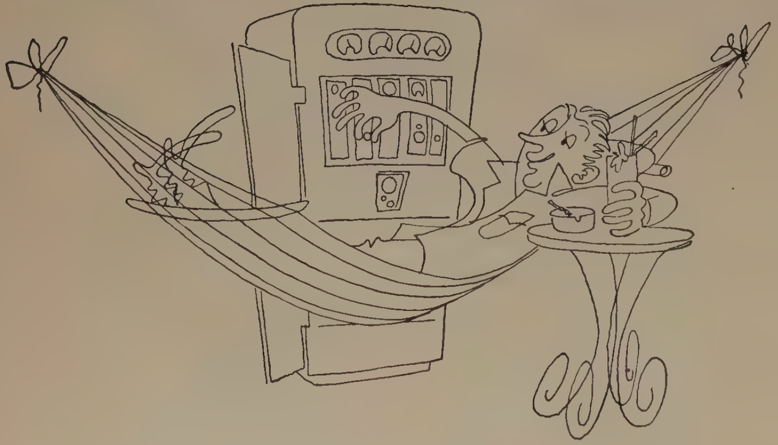
Complete modern facilities for laboratory testing and evaluation available.

Salary dependent upon experience and ability.

Contact Mr. J. C. Buckwalter
Chief Engineer

DOUGLAS

DOUGLAS AIRCRAFT COMPANY, Inc.
LONG BEACH, CALIFORNIA



Pleasant Working Conditions

So we're exaggerating a little! If you want to get technical about it (and you probably do) your life at our company won't be quite this cushy. We can promise this though—even the sky's not the limit for future opportunity. You work with a congenial group of engineers. People will listen to your ideas. The boss's door is always open. ***Who you are***—You're an Electronic or Mechanical Engineer. You're experienced in air communication and navigation circuitry and development. You have worked with low or high frequency circuits, instrumentation, component utilization or associated problems. ***What you do now***—Simple! Just contact:

Arthur E. Harrison, Vice President, Engineering
***wilcox* Electric Company, Inc.**
Fourteenth & Chestnut, Kansas City 27, Mo.

STAVID ENGINEERING, INC.

has openings for

GRADUATE ELECTRONIC and MECHANICAL ENGINEERS

Experience in design and Development of Radar and Sonar necessary.

Broad knowledge of Search and Fire Control Systems; Servo Mechanisms, Special Weapons, Microwave, Antennas and Antenna Mounts, etc.

Mechanical Engineer should also have experience in packaging of Electrical Equipment to Gov't specifications including design of complex cabinets, shock mounts and sway brace structures.

FIELD ENGINEERS

Qualified to instruct in the operation and supervise installation, maintenance and repair of Radar, Sonar and allied electronic equipments in the Field.

A chance to grow with a young and progressive company; salary and advancement commensurate with ability; liberal vacation, sick leave, 9 paid holidays, group life, sickness and accident insurance plans, and a worthwhile pension system.

Personnel Office, 312 Park Avenue
Plainfield, N.J.—Tel. Pl. 6-4806

ELECTRICAL ELECTRONIC and MECHANICAL ENGINEERS

Excellent opportunities in the field of

AUDIO AMPLIFIER DESIGN
SERVO AMPLIFIER DESIGN
COMPONENT DEVELOPMENT
EQUIPMENT DESIGN

Senior and Junior Engineers

Write, giving full details to:
Personnel Director, Dept. A,

GIBBS MANUFACTURING AND RESEARCH CORPORATION
Janesville, Wisconsin

ELECTRONICS ENGINEER

Group leader required to take charge of an electronics laboratory engaged in analytical instrument development. Design ability in conventional circuitry as applied to a.c. and d.c. amplifiers, power supplies, light detection devices, thyratron circuits, discriminators, magnetic circuitry and fractional horse-power motors desirable.

Five years experience or advanced degrees in lieu of part of this experience required. The position is a permanent one with an old established instrument company who is a leader in the field.

Send resume with salary requirements to:

Personnel Manager
FISHER SCIENTIFIC COMPANY
717 Forbes Street
PITTSBURGH 19, PA.

SPECIAL OPPORTUNITIES FOR

SENIOR ENGINEERS

Convair in beautiful, sunshiny San Diego invites you to join an "engineers" engineering department. Interesting, challenging, essential long-range projects in commercial aircraft, military aircraft, missiles, engineering research and electronics development. Positions open in these specialized fields:

Electrical Design
Mechanical Design
Structural Design
Structures
Weights
Servo-mechanisms
Aerodynamics
Thermodynamics
Operation Analysis
System Analysis

Generous travel allowances to those accepted. For free brochure, write Mr. H. T Brooks, Engineering Dept. 800

CONVAIR
IN BEAUTIFUL
SAN DIEGO

3302 PACIFIC HIWAY
SAN DIEGO 12, CALIFORNIA

ELECTRONIC ENGINEERS

EE or ME degree, minimum 3 years' experience in research and development work involving circuitry, servo-mechanisms, analogue computers, radar, and related equipment.

FIELD REPRESENTATIVES

A few openings for graduate engineers only with backgrounds similar to above. Continental U.S.A.

What You Can Expect at General Precision Laboratory

A progressive group of young, successful men, firmly established as designers and developers of electronic equipment . . . a medium-sized staff in which you receive individual recognition . . . a policy of promotion-from-within that helps qualified men move ahead swiftly . . . a modern laboratory located in a pleasant suburban community ideal for family living.

Expenses will be paid for qualified applicants who come for interviews. Please submit complete resume to:
Mr. H. F. Ware

GENERAL PRECISION LABORATORY
INCORPORATED
A Subsidiary of General Precision Equipment Corporation
63 BEDFORD ROAD, PLEASANTVILLE, NEW YORK

Ask the men who work here

We Need More Electronic Engineers.

We feel that the New London Instrument Company is a good place to work. We're sure you would agree if you knew more about us. . . .

But don't take our word for it. Write to any of our engineers and ask them. Address your letter to the men, in care of the company, and be sure to mark the envelope "Personal."

Here is the list of our engineers:

George A. Bangs, Jr.
Russell Berg
Ivan Bezugloff
Stanley Bogotch
F. Malcolm Comins
Morton H. Cohen
Joseph Collins
Howard Cox
Philbrook Cushing
Alexander Gordon
John C. Herrera
C. Boyd Norris
Stephen Phanos
Warren Rathbun
Ehud Rubinstein
Stanley Schaechter
Irving R. Versoy, Jr.
Ellsworth Wilson

Inquiries will be held in confidence.

New London Instrument Company
NEW LONDON, CONNECTICUT

....An Invitation To.... Experienced ELECTRONIC ENGINEERS and PHYSICISTS

We have several positions of technical leadership available in our growing Guided Missile Division. Applicants must have over four years experience and/or advanced degrees in either missile guidance systems, radar, servomechanisms, fire control computers, or U.H.F. techniques.

Our plant is located in beautiful suburban St. Louis, where you can enjoy the comforts of "county" living with easy access to "big city" shopping, entertainment, medical and educational facilities. Moving allowance for qualified applicants. Our Housing Representative will assist you in relocating.

Address replies to:
Technical Placement Supervisor
Box 516, St. Louis 3, Mo.

McDONNELL
Aircraft Corporation
ST. LOUIS 3, MO.

ELECTRONICS ENGINEERS

Experienced in any one of the following:

1. Electron Gun Design and Engineering
2. Cathode Ray Tube Engineering
3. Electronic Test Equipment Design
4. Cathode Ray Tube Quality Control
5. Screen Engineering
6. Aluminizing Engineering

THESE ARE EXCELLENT OPPORTUNITIES WITH A LARGE PROGRESSIVE MIDWEST CATHODE RAY TUBE MANUFACTURING PLANT.

SEND COMPLETE RESUME AND SALARY DESIRED TO BOX 737.

INSTITUTE OF RADIO ENGINEERS
1 East 79th St. New York 21, N.Y.

NORDEN

OFFERS UNUSUAL OPPORTUNITIES FOR COMPETENT ENGINEERS

Electronic
Mechanical
Electro-Mechanical

FOR RESEARCH AND DEVELOPMENT WORK ON

Servo Mechanisms
Microwave Equipment
Antennas
Infrared Equipment
Communications Equipment
Computers
Gyroscopes
Radar

- Liberal Hospitalization Plan
- Merit Salary Reviews
- Excellent Working Conditions
- Ideally located in Westchester County

•

Please telephone or send resume and salary requirements to the Personnel Department. All inquiries will be handled in confidence.

•

THE NORDEN LABORATORIES CORPORATION
121 Westmoreland Avenue
White Plains, New York
White Plains 6-4300

An assurance is required that the relocation of an applicant will not cause disruption of an urgent military project.

Remington Rand

UNIVAC

ENGINEERS

Electronic • Electro-Mechanical • Mechanical

The manufacturers of the UNIVAC—the first electronic, general-purpose, digital computer system to be sold commercially—have interesting and important positions with challenging futures. Engineers and physicists are needed for work at all levels in any of the following fields:

System Studies
Logical Design
New Components
Solid State Physics
Semi-conductors
Magnetic Materials
Storage Techniques
Circuit Design
Pulse Techniques
Input-Output Devices
Product Design
Test Equipment Design
Computer Development and Design
High Speed Electro-Mechanical Devices
System Test and Maintenance

Design Research Development Test

Our rapidly expanding engineering and production programs have created many permanent positions paying excellent salaries. These positions offer outstanding opportunities for professional development. The possibilities for graduate study in this locale are excellent and the Company's plan for reimbursement of tuition expenses is extremely liberal. Other Company benefits include retirement and group insurance plans and the payment of moving expenses.

Replies kept strictly confidential. Interviews arranged at our expense.

REMINGTON RAND INC.
Eckert-Mauchly Division
2300 West Allegheny Avenue, Philadelphia 29, Pennsylvania
Telephone: BAldwin 3-7300.

Engineers

Open this door to a bright future!

- TV RECEIVER DESIGN ENG.
- ELECTRONICS ENG.
- FIELD ENGINEERS
- TEST & INSPECTION ENG.
- COMPONENTS ENG.

You're needed to work on: Radar, G.C.A., Mobile Radio, Auto Radio, Airborne Communication & Navigation Equipment, Television, Antennas, Microwave Equipment, Servo Mechanisms and Guided Missiles.

You will benefit from high wages, a modern, air-conditioned plant, paid vacations and holidays, group insurance and a good chance for advancement.

Housing immediately available in the beautiful suburban and county areas that surround the Bendix Radio plant.

Write,
Wire or Phone
MR. E. O. COLE
Dept. M

Bendix Radio
DIVISION OF BENDIX AVIATION CORPORATION
Baltimore-4, Md. Phone: VAlley 3-2200
Makers of the World's Finest Electronic Equipment

ELECTRONIC ENGINEERS

SENIORS: To act as a group leaders on design, development and production of radio, radar, television transmitters, receivers and test equipment.

SPECIALISTS: (2) Microwave circuitry and UHF plumbing, preferably with microwave test equipment design experience.

Must have minimum five years practical experience, including knowledge of Government specifications, airborne, ground and/or naval equipments. Excellent opportunity for advancement. Write, giving outline of education, experience, background and salary expected, to

Engineering Personnel Department
FREED ELECTRONICS AND CONTROLS CORPORATION
200 Hudson Street, New York 13, N.Y.

CHICAGO MIDWAY LABORATORIES
THE UNIVERSITY OF CHICAGO
ELECTRONICS ENGINEERS and PHYSICISTS

for work on a long-range research and development program in air armament for the Air Force. Openings on both senior and junior levels in

INFRARED
RADAR
COMPUTERS
INSTRUMENTATION
AIRBORNE ORDNANCE
ELECTRONIC COMPONENTS
ELECTRONIC SYSTEMS

Complete modern laboratory and shop facilities are available. This is a new and expanding program with excellent opportunities for advancement. Advanced study encouraged in nearby facilities.

We offer salaries equivalent to industry, as well as a one-month paid vacation. Applicants must be U.S. citizens.

Director of Scientific Personnel
CHICAGO MIDWAY LABORATORIES
6040 South Greenwood Avenue
BUtterfield 8-6611
Chicago 37, Illinois

POSITIONS OPEN

(Continued from page 132A)

ELECTRONIC INSTRUCTORS

A Detroit electronic engineering school needs teaching personnel to teach radio and television in an expansion program. Prefer men with U. S. Navy radio technician training who have taught in Navy radio technician schools and who had a rating of ETM 1/c or higher. Salary open, depending upon education and experience. Send resume of education and experience. Office of the Dean, 2457 Woodward Ave., Room 901, Detroit 1, Mich.

RADIO AND TV ENGINEER

Interesting permanent job, testing and analyzing sets, FM-AM receivers, high fidelity sound equipment, etc. in New York City laboratory. Degree and 3 years experience in industry. Familiar with IRE test methods. Salary commensurate with ability and experience. Send resume. Box 729.

ENGINEER

An established manufacturer of TV deflation yokes and other electronic products offers an excellent opportunity for an engineer with experience in manufacturing and supervision of production personnel. Background in design of yokes and winding machinery desirable. Manufacturer located in Michigan. Attractive salary arrangement and congenial associates. Mail resume of education and commercial experience to Electro Engineering & Mfg. Co., 627 W. Alexandrine, Detroit 1, Mich.

(Continued on page 143A)

An Opportunity

is offered for intelligent, imaginative engineers and scientists to join the staff of a progressive and self-sustaining, university-affiliated research and development laboratory. We are desirous of expanding our permanent staff in such fields as electronic instrumentation, missile guidance, microwave applications, design of special-purpose electronic computers, and in various other applied research fields of electronics and physics.

Salary structure and benefit programs are on a par with industry. In addition, there are many tangible advantages, such as our self-sponsored internal research policy, of interest to men with ingenuity and initiative.

CORNELL AERONAUTICAL LABORATORY, INC.
BUFFALO 21, NEW YORK

ENGINEERS

Systems
Radar
Servo
Computer

BACKGROUND:

Responsible positions open for top level development and project engineers with practical and research experience in:

- Advanced Electronic Circuits and Systems
- Microwave Radar
- Microwave Receivers and Transmitters

Also Engineering Design and Analysis relating to fields such as:

- Analogue and Digital Computers
- Servomechanisms
- Communications
- Navigation
- Fire Control
- Optical

Requirements emphasize advanced analytical and/or management experience on highly complex electronic and electro-mechanical systems.

Kindly send
resume and
salary requirements to:

MAXSON

The W. L. MAXSON Corp.
460 W. 34th ST., NEW YORK 1, N.Y.

Communication Engineers

with experience in the fields of

Systems Engineering
Information Theory
Circuit Development
Electro-mechanical Development
Equipment Engineering

Advancements in the fields of wave propagation, translation of information, communication theory, circuit techniques and equipment miniaturization have created a number of new openings for qualified engineers in the Hughes Advanced Electronics Laboratory.

THE COMPANY

Hughes Research and Development Laboratories, located in Southern California, form one of the nation's leading electronics organizations. The personnel are presently engaged in the development and production of advanced electronics systems and devices.

AREAS OF WORK

The communication group is concerned with the design and development of unique radio communication systems and with exploiting new radio communication techniques. Specialists in propagation phenomena, antenna systems, network theory, magnetic recording, wide-band amplification, and intricate electromechanical devices are active in this program.

THE FUTURE

Engineers who enjoy a variety of problems requiring originality and ingenuity find the proper environment for personal advancement in these activity areas. Widespread future application of advanced communication techniques will enable the Hughes engineer to take full advantage of his experience as the Company expands commercially.

How to apply

Write today, giving details of qualifications and experience. Assurance is required that relocation of the applicant will not cause disruption of an urgent military project.

Hughes
RESEARCH AND DEVELOPMENT LABORATORIES

Scientific and Engineering Staff

CULVER CITY,
LOS ANGELES
COUNTY,
CALIFORNIA

ELECTRONIC DESIGNERS

Design of mechanical and electrical components and chassis in UHF and microwave systems.

RADIO ENGINEERS

Development of radio and radar components and systems.

ENGINEERS

Design of components for magnetic deflection of Cathode Ray Tubes.

KOLLSMAN INSTRUMENTS

To Men Who Want the Best

Kollsman provides excellent facilities for the design and development of America's finest aircraft instruments. In our modern radio communications group you'll find a congenial atmosphere in which you can do your best work. You'll be encouraged to advance as our progressive organization continues to grow. And you'll receive liberal benefits including paid life, hospitalization, surgical, accident and health insurance.

KOLLSMAN INSTRUMENT CORP.

80-08 45th Ave. Elmhurst, Long Island, N.Y.

A NEW Bendix Division!
A NEW Electronic Product!
NEW JOB OPPORTUNITIES

In our modern plant at York, Pennsylvania, this new division of Bendix Aviation Corporation is producing a new electronic product. This division has a big future; and this is *your* opportunity to get in on the ground floor, with excellent possibilities for rapid advancement. We need the following:

- **ELECTRONICS ENG.**
- **MECHANICAL ENG.**

Also We have many openings for men qualified by education or experience in all phases of electronics.

YOU BENEFIT With the Bendix York Division, you will benefit from high wages, paid vacations and holidays and ideal living conditions in a beautiful suburban area.

Write, Wire or Phone
Department Y-2

Bendix

AVIATION CORPORATION
YORK DIVISION

Phone: York 5521 York, Penna.

---

notes of interest
to
electronic engineers

Sperry

- An opportunity to do highly creative work with an expanding organization in an important, long-range field.
- Enjoy the advantages of living in Danbury, Connecticut, a comfortable, scenic, New England suburb within 2 hours' drive of New York City.
- Independent research projects in which imagination and initiative are encouraged.
- Excellent working conditions in a new and modern plant.
- You can expect prompt recognition of abilities and accomplishments.
- Moving expenses paid. 40 hour week with pay for overtime.

Positions Are Now Open For Men With Experience In:

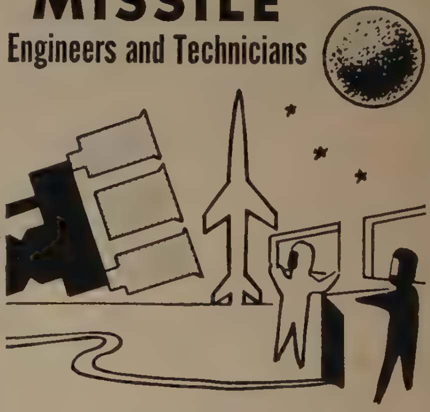
Design of circuits for radar, sonar, servo systems, analogue or digital computers, or data storage systems or design of electronic test and measurement equipment used to test any of the foregoing.

Address all inquiries to J. H. McCann

SPERRY PRODUCTS, Inc.

DANBURY CONNECTICUT

MISSILE
Engineers and Technicians



For Field Test Positions in
NEW MEXICO
"The Land of Enchantment"
ON

Guidance Flight Testing
Servomechanisms
Telemetering Test Equipment
Airborne Electronics Equipment

IDEAL WORKING CONDITIONS

WRITE: FIELD TEST DIRECTOR
P. O. BOX 391
HOLLOMAN AIR DEVELOPMENT CENTER
NEW MEXICO

BELL *Aircraft* CORPORATION

Positions Open

(Continued from page 138A)

MANUFACTURERS' REPRESENTATIVES

Manufacturers' representatives wanted to represent line of magnetically and electronically regulated D.C. power supplies. Write stating present lines and territory. Perkin Engineering Corp. 345 Kansas St., El Segundo, Calif.

INFORMATION THEORY PHYSICISTS AND ENGINEERS

Positions are open on the staff of Paul Rosenberg Associates, a firm of consulting physicists engaged in unusually interesting research and development projects for the Armed Services and for private industry. Senior physicists with Ph.D. and considerable post-graduate experience, or senior research engineers with equivalent training and experience preferred. A background of information theory is desirable. U. S. citizenship is required. Applications will be held confidential. Send complete resume. Paul Rosenberg Associates, 100 Stevens Ave., Mt. Veronon, N.Y.

TECHNICAL WRITERS

A leading New York company in the field of technical manuals has openings for electronic engineers to write government instruction books. Technical writing experience is desirable but not necessary. The field of technical writing offers the engineer an opportunity to survey a broad portion of the engineering field, and to familiarize himself with the newest circuits, techniques, and equipments. Send resume stating salary requirements to Box 733.

INSTRUCTORS

The California State Polytechnic College has openings in the Electronic and Radio Engineering Department. (1) Teaching courses dealing with the operation, principles, and maintenance of communication equipment. Commercial experience required. (2) Teaching advanced electronic engineering circuit courses. Industrial experience required. For information write: Harold P. Hayes, Dean of Engineering, San Luis Obispo, California.

Positions Wanted By Armed Forces Veterans

In order to give a reasonably equal opportunity to all applicants and to avoid overcrowding of the corresponding column, the following rules have been adopted:

The Institute publishes free of charge notices of positions wanted by I.R.E. members who are now in the Service or have received an honorable discharge. Such notices should not have more than five lines. They may be inserted only after a lapse of one month or more following a previous insertion and the maximum number of insertions is three per year. The Institute necessarily reserves the right to decline any announcement without assignment of reason.

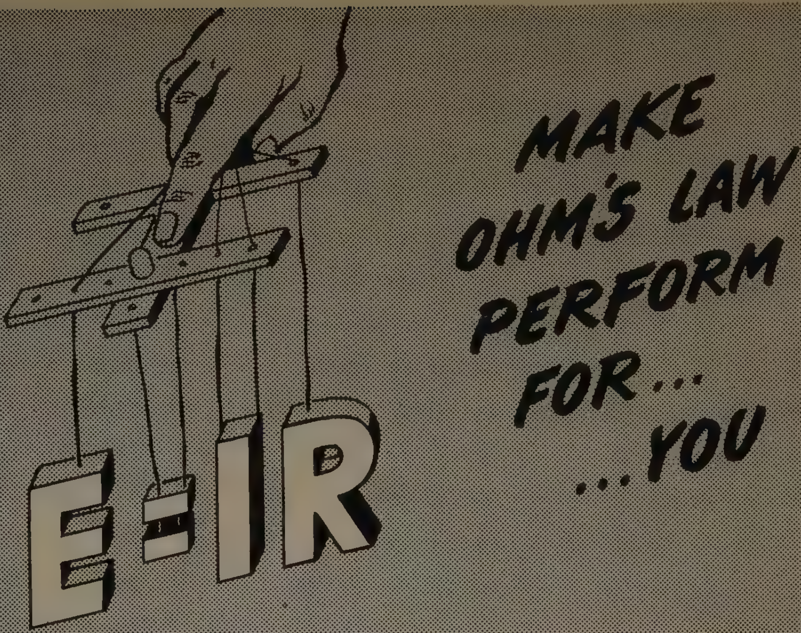
ENGINEER

S.B.-MIT. 1945. Age 28, married, 2 children. Varied experience in servomechanisms, digital computers, helium liquefaction, and project engineering. Desires technical liaison, sales, or administrative position in England or Europe. Box 630 W.

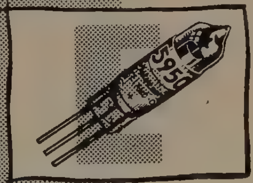
ENGINEER

B.S.E.E. 1950. Age 29, married. VHF-UHF receiver development and product design. Desires position in research and development in same field. Box 631 W.

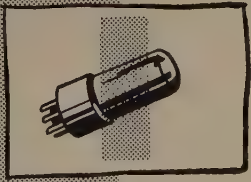
(Continued on page 144A)


MAKE OHM'S LAW PERFORM FOR... ...YOU
E=IR

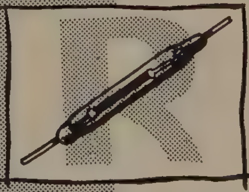
Yes! You can make Ohm's law perform for you. How? By choosing the right Victoreen Component. Whether it is CONSTANT VOLTAGE, CONSTANT CURRENT, or CONSTANT RESISTANCE you require, Victoreen offers you a wide range of components specifically engineered to fix accurately the value of any factor in Ohm's law.



VOLTAGE REGULATOR TUBES
Range: 50 to 20,000 volts
currents 5 to 3000 μa
CLOSE REGULATION—MINIATURIZED—
LOW DRAIN—LONG LIFE



CURRENT REGULATOR TUBES
Range: 25 to 6000 Milliamperes
voltage drop 1 to 100 V
MANY TYPES AND BULB SIZES—
INEXPENSIVE—RELIABLE OPERATION

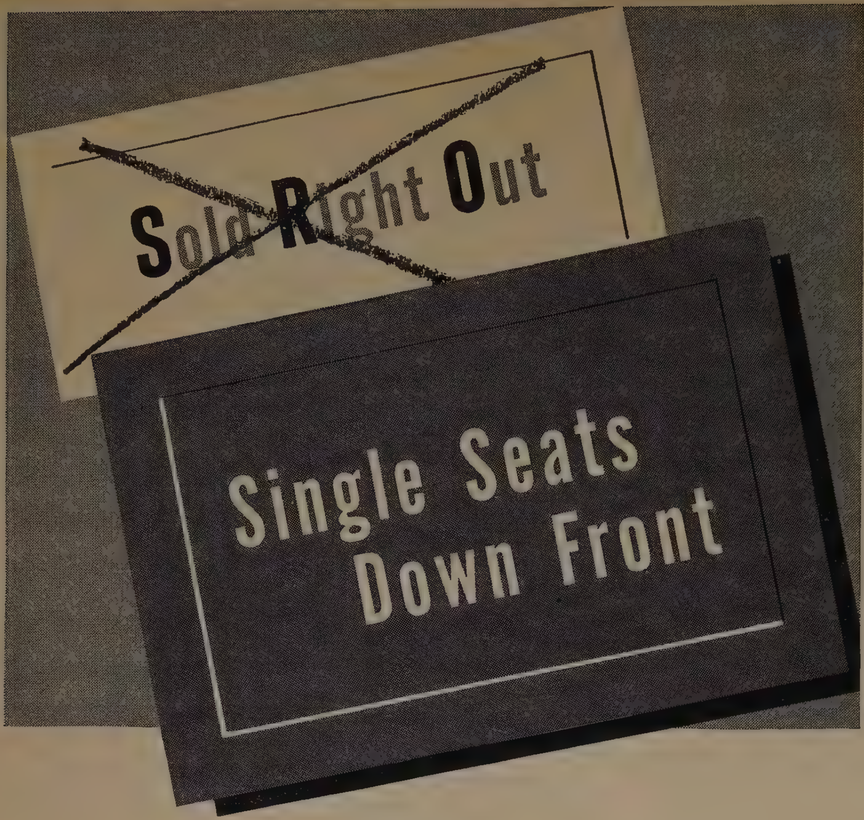


PRECISION RESISTORS
Range: 200 to 100,000,000,000,000 ohms
VACUUM SEALED IN GLASS FOR EXTREME STABILITY—POWER TO 5 WATTS—HIGH ACCURACY—1% TOLERANCE

Consult our Technical Services department for specifications and recommendations for your applications.

SPECIFY FORM 3016 . . . WHEN REQUESTING FACTUAL CATALOG OF VICTOREEN COMPONENTS

The Victoreen Instrument Co.
3800 PERKINS AVE. • CLEVELAND 14, OHIO



Our previous series of advertisements in this publication explained, in theatrical parlance, that our design and production facilities were pretty well "sold out" by the requirements of our present customers.

Now, we are happy to say (because we enjoy making new friends) that some of the heat has been taken off, and we are able to announce "Limited seating available"—as they say at the box office.

We shall be happy to talk with you about your present and/or future needs.

L. H. Terpening Company
DESIGN • RESEARCH • PRODUCTION
Microwave Transmission Lines and Associated Components
16 W. 61st St. • New York 23, N.Y. • Circle 6-4760

TRADE MARK

Positions Wanted

(Continued from page 143A)

ENGINEER

B.S.E.E. Brown University 1952, 24, married, former ET2, plant engineering experience. Diversified test engineering work on helicopters since graduation. Desires more design, preferably servo systems with company that acknowledges engineers. Available immediately. Any location, future only criterion. Box 662 W.

ENGINEER

B.S. in physics. 2½ years Navy electronic technician; 2 years electronic and servomechanisms engineering experience. Desires position in project or industrial engineering. Age 25, married, child. Box 663 W.

ELECTRONIC ENGINEER

B.E.E. Cornell 1951. Graduate studies in economics. Age 24, married. 1st Lt., USAF, Research and Development Officer, electron tubes. Familiar with JAN-MIL specifications and Government contracts. Interested in position requiring economics and CRT knowledge-experience. Available August 1953. Box 664 W.

ENGINEER

Electronic-B.E.E.-Jr. Desires position leading to design of pulse and associated circuitry. Basic electronic design methods already acquired. Education towards M.E.E. at Polytechnic Institute of Brooklyn. New York City area desired. Box 665 W.

SALES ENGINEER

Graduate Electrical Engineer, B.S.E.E. Desires position in sales and applications of electronic equipment. 3½ years experience in electronic field engineering; 2 years teaching practical electronic design; 2 years as Navy ETM. Member of Tau Beta Pi, and the IRE. Age 26, married, 1 child. Box 666 W.

ENGINEER

B.S.E.E. June 1952 from Iowa State College. 1 year experience in airborne radar and computer system. Age 24, married, 2 children. Desires foreign assignment with suitable living conditions for family. Salary open. Box 667 W.

ENGINEER

Air Force officer, now on active duty with Wright Air Development Center, expects release in June 1953. B.S. in M.E. Graduate studies in industrial engineering. Age 30, married. Several years experience business administration and electronic development and production. Desires position in management or production engineering in New York area. Box 668 W.

ADVERTISING & PUBLIC RELATIONS MANAGER

B.S. Engineering/Business administration, MBA Marketing. 10 years progressive experience in all phases of industrial promotion: program planning, budgeting and administration, agency and media liaison, space and promotional copy planning, writing and editing; pamphlets and brochures, technical publicity. Press, industry and Government relations. Licensed radio operator with background in radio and electronic equipment promotion. Age 33, single. Box 669 W.

(Continued on page 149A)

PROFESSIONAL CARDS

ALFRED W. BARBER LABORATORIES
Specializing in the Communications Field and in Laboratory Equipment
Offices, Laboratory and Model Shop at:
32-44 Francis Lewis Blvd., Flushing, L.I., N.Y.
Telephone: Independence 3-3306

CROSBY LABORATORIES, INC.
MURRAY G. CROSBY & STAFF
RADIO-ELECTRONIC RESEARCH
DEVELOPMENT & MANUFACTURING
COMMUNICATIONS, FM & TV
ROBBINS LANE
HICKSVILLE, NEW YORK
HICKSVILLE 3-3191

ELDICO OF NEW YORK, INC.
Donald J. S. Merten and Engineering Staff
Consultants on Interference Elimination from Transmitters, Induction Heaters, Diathermy, etc.
44-31 Douglaston Parkway, Douglaston, L.I., N.Y.
Bayside 9-8686

ELECTRO-METRIC INSTRUMENT CO.
A. Newton, Director of Eng.
Circuit analysis, design and development in the fields of VHF, UHF tuners, TV receivers and accessories, laboratory and test instrumentation.
241 Centre Street, New York 13, N.Y.
Canal 6-1337

Richard B. Schulz
Electro-Search
Radio-Interference Reduction;
Development of
Interference-Free Equipment,
Filters, Shielded Rooms
4337 N. 5th Street, Philadelphia 40, Pa.
GLadstone 5-5353

ELK ELECTRONIC LABORATORIES, INC.
Jack Rosenbaum
Specializing in design and development of Test Equipment for the communications radar and allied fields
333 West 52nd St., New York 19, PL-7-0520

F-R MACHINE WORKS INC.
ELECTRONICS FXR X-RAY DIVISION
DESIGN - DEVELOPMENT - MANUFACTURE
44-14 Astoria Boulevard Long Island City 3, N.Y.
Phone AStoria 8-2800

FREDERICK RESEARCH CORP.
BETHESDA 14, MARYLAND
Carl L. Frederick, D.Sc., Pres.
Tel: Washington, D.C., OLiver 4-3229
Research, Specifications, Development, Engineering, Manufacture, Technical Writing, Offset Printing—Fields of Test Equipment, Radio Interference, Tuners, Circuits, Electromechanical Systems, Components.

HARRIS GALLAY Consultant
Electronic Project Development for Industry
Day, Week, and Duration of Project Services
Our Laboratory Facilities Optional
Plymouth 9-4237 · 60 Perry St., Belleville 9, N.J.

PAUL GODLEY CO.
Consulting Radio Engineers
P.O. Box J, Upper Montclair, N.J.
Offs & Lab.: Great Notch, N.J.
Phone: Montclair 3-3000
Established 1926

GOVERNMENT CONTRACT LIAISON AND CONSULTANTS
GORDON ASSOCIATES, INC.
Specializing in Signal Corps Electronic Requirements, Technical Manuals, Tabular List of Parts, Drawings
L. Gordon, Pres. P. Treston, Ch. Engr.
157 Broad Street Telephone
Red Bank, New Jersey Red Bank 6-2743

HIGHLAND ENGINEERING CO.
William R. Spittal & Staff
Design, Development and Manufacture of Transformers, Chokes, Etc. for the Electronic, Industrial and Allied Fields
Main & Urban, Westbury, L.I., N.Y.
WE-7-2933

HOGAN LABORATORIES, INC.
John V. L. Hogan, Pres.
APPLIED RESEARCH, DEVELOPMENT, ENGINEERING
Est. 1929. Electronics, Optics, Mechanisms, Facsimile Communication, Digital Computers, Electro-sensitive recording media, Instrumentation.
155 Perry Street, New York 14 CHelsea 2-7855

LEONARD R. KAHN
Consultant in Communications and Electronics
Single-Sideband and Frequency-Shift Systems
Diversity Reception - Modulation Theory
Applications of Magnetic Tape Recording
Elizabeth Bldg., 22 Pine St., Freeport, L.I., N.Y.
Freeport 9-8800

DAVID C. KALBFELL, Ph.D.
KAY-LAB Electronic Instruments
Laboratory and Manufacturing Facilities
Specializing in Electronic
Instrumental and Industrial Problems
1090 Morena Blvd. Woodcrest 6359
San Diego 10, California

HARRY R. LUBCKE
CONSULTING TELEVISION ENGINEER
Television Engineering Since 1929
Electronics
2443 CRESTON WAY HO. 9-3266
HOLLYWOOD 28, CALIFORNIA

MEASUREMENTS CORP.
RESEARCH & MANUFACTURING ENGINEERS
Harry W. Houck Jerry B. Minter
John M. van Beuren
Specialists in the Design and Development of Electronic Test Instruments
BOONTON, N.J.

L. J. CASTRIOTA M. WIND
S. W. ROSENTHAL P. G. MARIOTTI
Microwave Consultants
Radio Frequency and Microwave Components
Cable—Waveguide—Coax
Telephone G.P.O. Box 844
BOulevard 3-2096 Brooklyn 1, N.Y.

MICROWAVE SERVICES, INC.
"Architects of Modern Communications"
CONSULTANTS, ENGINEERS, CONSTRUCTORS
Wire, Carrier, Radio—Inside and Outside Plant Facilities
S. K. Wolf, E. Labin, V. J. Nexon, and Associates
45 Rockefeller Plaza, New York 20 Circle 7-4953

PICKARD AND BURNS, INC.
Consulting Electronic Engineers
Analysis and Evaluation of Radio Systems
Research, Development, Design and Production of Special Electronic Equipment and Antennas.
240 Highland Ave. Needham 94, Mass.

PSC APPLIED RESEARCH LTD.
Development & Production
AIRCRAFT and INDUSTRIAL
INSTRUMENTS ● AIDS ● SYSTEMS
Navigation - Survey - Processing - Servo
Gyro - Photo - Magnetic - Electronic
Radiation - Optical
J. M. Bridgman, General Manager
1450 O'Connor Drive Toronto, Canada

Paul Rosenberg Associates
Consulting Physicists
100 STEVENS AVE. • MOUNT VERNON, NEW YORK
CABLE: PHYSICIST MOunt vernon 7-8040

TELECHROME, INC.
Electronic Design Specialists
COLOR TELEVISION EQUIPMENT
Flying Spot Scanners, Color Synthesizers, Keyers, Monitors, Oscilloscopes and Related Apparatus
J. R. Popkin-Clurman, Pres. & Ch. Engr.
88 Merrick Rd. Amityville, L.I., N.Y.

TELREX, INC.
M. D. Ercolino, Pres.
H. F. ANTENNA SPECIALISTS
Communication Arrays
Reception or Transmission
For FM, TV, and Amateur Service.
Asbury Park, N.J.—Phone AP 2-7252

WHEELER LABORATORIES, INC.
Radio and Electronics
Consulting — Research — Development
R-F Circuits — Lines — Antennas
Microwave Components—Test Equipment
Harold A. Wheeler and Engineering Staff
Great Neck, N.Y. Great Neck 2-7806

30,000 ENGINEER MEMBERS will receive and use the 1953 IRE DIRECTORY

INDEX AND DISPLAY ADVERTISERS

Meetings with Exhibits 2A
News and New Products 12A
Industrial Engineering Notes 66A
Section Meetings 86A
Student Branch Meetings 92A
Membership 102A
Positions Open 128A
Positions Wanted by Armed Forces Veterans 143A

DISPLAY ADVERTISERS

A'G'A (Div. Elastic Stop Nut Corp.) 124A
Ace Engineering & Machine Co. 121A
Acme Electric Corp. 98A
Aerovox Corp. (Hi-Q Div.) 41A
Aircraft Armaments Inc. 130A
Aircraft Transformer Corp. 83A
Airtron, Inc. 84A
Alden Products Co. 52A
Allen-Bradley Co. 3A
Allied Radio Corp. 147A
American Electric Motors 88A
American Lava Corp. 15A
American Phenolic Corp. .... 76A & 77A
American Television & Radio Co. 18A
Amperite Company, Inc. 66A
Ampex Electric Corp. 35A
Andrew Corp. 58A
Arnold Engineering Co. 16A
Associated Specialties Co. 156A
Automatic & Precision Mfg. Co. 148A

Ballantine Laboratories, Inc. 113A
Barber Laboratories, Alfred W. 157A
Bell Aircraft Corp. 140A
Bell Telephone Laboratories 4A
Bendix Aviation Corp. (Eclipse-Pioneer) 68A
Bendix Aviation Corp. (Radio Div.) 138A
Bendix Aviation Corp. (York Div.) 140A
Berkeley Scientific 127A
Blaw-Knox Company 57A
Bodnar Industries, Inc. 158A
Boonton Radio Corp. 54A
Borg Equipment Div., Borg. Corp., George W. 105A
Brush Electronics Co. 99A
Burlington Instrument Co. 116A
Burroughs Electronic Instruments .... facing 32A & 33A
Bussmann Mfg. Co. 31A

CBS-Hytron Div. Columbia Broadcasting System, Inc. 45A
Cambridge Thermionic Corp. 28A
Cannon Electric Co. 145A
Canoga Corp. 122A
Capehart-Farnsworth Corp. 130A
Cargo Packers, Inc. 127A
Centralab (Div. of Globe Union) 63A
Chicago Midway Laboratories 138A
Chicago Telephone Supply Corp. .... 100A & 101A
Clare & Co., C. P. 55A
Clarostat Mfg. Co., Inc. 27A
Clevite-Brush Development Co. 130A
Cohn Corp., Sigmund 154A
Collins Radio Co. 23A
Communication Products Co. 123A
Communications Equipment Co. 155A
Consolidated Vultee Aircraft Corp. (Convair) 135A
Cornell Aeronautical Laboratory, Inc. 138A
Cornell-Dubilier Electric Corp. .... Cov. III
Corning Glass Works 89A
Cosa Corp. 34A
Crosby Laboratories, Inc. 157A
Crucible Steel Co. of America 71A

DX Radio Products, Inc. 124A
Dale Products, Inc. 56A
Dalis, Inc., H. L. 121A
Daven Co. 13A
Dialight Corp. 82A
Douglas Aircraft Co. 134A
DuMont Labs., Allen B. 22A

REGULATED HIGH VOLTAGE POWER SUPPLY

Provides Electronically Regulated, Continuously Adjustable Voltages from 150 to 1500 VDC at 0-5 Milliamperes

This unit is specially designed to supply proper power for making precise quantitative measurements with photomultiplier tubes, klystrons and similar applications.

Voltages are held to close limits even with wide line voltage and load variations.

No meter is required. Accurate voltage readings are made directly from a 15 turn vernier dial which is calibrated to read 1 volt per scale division.

Write for Literature on Other High Voltage Regulated Power Supplies

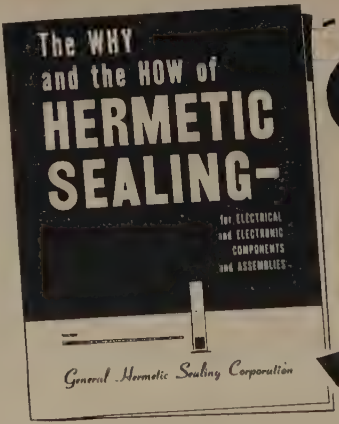
MODEL 810-P SPECIFICATIONS

- **OUTPUT VOLTAGE:** 150 to 1500 VDC at 0-5 Milliamperes.
- **REGULATION:** Output voltage varies less than .01% per volt change of line voltage and less than .1 volt with variation of output current from 0 to 5 Milliamperes.
- **RIPPLE:** Less than 5 Millivolts r.m.s.

Positive output terminal is grounded. 5 negative output connectors (type AN-3102A-18-16-s) are connected in parallel and mounted on front panel.

WRITE FOR DESCRIPTIVE BULLETIN

FURST ELECTRONICS
3326 W. Lawrence Ave., Chicago 25, Illinois



HERMETICALLY SEALED ELECTRICAL and ELECTRONIC COMPONENTS and ASSEMBLIES

- Meet Military Specifications
- Unexcelled High Altitude Operation
- Permanent Protection Against Corrosion, Oxidation, Dust
- Forever Free from Humidity Effects
- Explosion Proof and Fungus Proof
- All assemblies are evacuated, inert gas filled, and 100% Mass Spectrometer Leak tested

Write for folder—*The HOW & WHY of Hermetic Sealing*

GENERAL HERMETIC SEALING CORPORATION
99 East Hawthorne Ave., Valley Stream, N. Y.
Valley Stream 5-6363

There is Always One Leader in Every Field

BODNAR INDUSTRIES, Inc.

leads in the field of

TRANSILLUMINATED PLASTIC LIGHTING PLATES

BECAUSE OF *Quality* • *Uniformity* • *Performance*
Design & Layout "Know-How Service"
Quantity Production Promptly

NEW YORK —19 Railroad Ave., New Rochelle (Home Office)
TEXAS —Jefferson Tower Building, Dallas
CALIFORNIA—11056 Cumpston St., N. Hollywood
CANADA —313 Montreal Trust Bldg., 67 Yonge St., Toronto

SPECIMEN PANEL MIL-P-7788 (AN-P-89) SENT ON LETTERHEAD REQUEST

Not Recommended

Operation of transistorized equipment under water is not recommended procedure. The reason: Humans are not constituted for underwater operation over protracted periods of time.

This is just one silly way of trying to impress you with the fact that, although we don't really recommend operating our Germanium Products Corp.'s transistors under water, laboratory experiments plus field reports indicate that these units do stand up pretty darn well under conditions of high humidity. Of course, we can speak only for **our own** units and not for others.

For instance, in our lab a handful of our regular type RD2520's were immersed in distilled water at room temperature —

After three months the Rc had dropped to 150,000 ohms, but all other parameters had remained precisely the same as in the original specs.

After 7 months the average Rc was 50,000 ohms. Ico showed a slight increase over original specs, but the units still had good power gain and good power output at 1.5 Volts. **All units had maintained their original high Alpha value.**

Application after application shows that our transistors are highly resistant to the adverse effects of humidity.

Three types of NPN grown-junction transistors now available: RD2517—.90 min. alpha, RD2520—.95 min. alpha, RD2525—.99 min. alpha. For complete data, price and delivery quotations, or an engineering consultation, phone, wire or write...

FEDERATED SEMI-CONDUCTOR CO.

Exclusive sales agents for GERMANIUM PRODUCTS CORP.
66 DEY STREET, NEW YORK 7, N. Y. PHONE DIgby 9-3050
TELETYPE NY 1-2859 VIA WESTERN UNION WUX
MANUFACTURED UNDER WESTERN ELECTRIC CO. LICENSE

DISPLAY ADVERTISERS

Eitel-McCullough, Inc. 14A & 113A
Eldico of New York, Inc. 157A
Electrical Industries 81A
Electrical & Physical Instr. Corp. 120A
Electro-Metric Instrument Co. 157A
Electro Motive Mfg. Co., Inc. 61A
Electro-Search 157A
Electronic Engineering Co. of Calif. 128A
Electronic Research Associates 150A
Electronic Tube Corp. 70A
Elk Electronic Laboratories, Inc. 157A
Engineering Associates 152A
Engineering Research Assoc., Inc. 128A
Erie Resistor Corp. 11A

F-R Machine Works 157A
Fairchild Camera & Instr. Corp. 50A
Fairchild Engine & Airplane Corp. (Guided Missile) 37A
Fansteel Metallurgical Corp. 74A
Federated Semi-Conductor Co. 159A
Film Capacitors, Inc. 125A
Filtron Company, Inc. 24A
Fisher Scientific Co. 135A
Ford Instrument Co. 114A
Freed Electronics and Controls Corp. 138A
Frederick Research Corp. 157A
Frequency Standards 114A
Fugle Miller Laboratories 126A
Furst Electronics 158A

Gallay, Harris 157A
General Ceramics & Steatite Corp. 33A
General Electric Co. (Apparatus) 44A
General Electric Co. (Empl.) 133A
General Electric Co. (I. & T. Tubes) 51A
General Hermetic Sealing Corp. 158A
General Precision Laboratory, Inc. 136A
General Radio Company Cov. IV
Giannini Company, G. M. 39A
Gibbs Mfg. & Research Corp. 130A & 135A
Gilfillan Bros., Inc. 133A
Godley Company, Paul 157A
Gordon Associates 157A
Guardian Electric Mfg. Co. 53A
Guthman & Co., Inc., Edwin I. 115A

Hammarlund Mfg. Co., Inc. 2A
Harvey Radio Co., Inc. 152A
Heiland Research Corp. 123A
Heinemann Electric Co. 62A
Helipot Corp., The 65A
Heppner Mfg. Co. 92A
Hermetic Seal Products Co. 25A
Hewlett Packard Co. 85A
Hickok Electrical Instrument Co. 19A
Highland Engineering Co. 157A
Hoffman Radio Corp. 130A
Hogan Laboratories, Inc. 157A
Hudson Tool & Die Co., Inc. 73A
Hughes Aircraft Co. 29A
Hughes Research & Development Labs. 132A & 139A
Hycor Co., Inc., The 120A

Iliffe & Sons, Ltd. 60A
Industrial Test Equipment Co. 151A
Institute of Radio Engineers 2A, 110A & 111A
International Rectifier Corp. 95A

Johnson Company, E. F. 125A

Kahle Engineering Co. 107A
Kahn, Leonard R. 157A
Kalbfell Laboratories 157A
Kay Electric Company 123A
Kenyon Transformer Co., Inc. 107A
Ketay Mfg. Corp. 8A
Knights Company, James 103A
Kollmorgen Optical Corp. 105A
Kollsman Instrument Corp. 119A
Kollsman Instrument Corp. 140A

Laboratory for Electronics, Inc. 87A
Lambda Electronics Corp. 117A
Lapp Insulator Co., Inc. 90A
Lenz Electric Mfg. Co. 26A
Lewis & Kaufman, Ltd. 117A
Librascope, Inc. 94A
Lord Manufacturing Co. 102A
Lubcke, Harry R. 157A

DISPLAY ADVERTISERS

Magnavox Co., The 132A
Mallory & Co., Inc., P. R. 10A, 42A
Marion Electrical Instrument Co. 49A
Maxson Corp., W. L. 139A
McDonnell Aircraft Corp. 136A
Measurements Corp. 157A
Measurements Corp. 113A, 156A
Melpar, Inc. 128A
Microlab 151A
Microwave Consultants 157A
Microwave Services, Inc. 157A
Midland Manufacturing Co., Inc. 21A
Millen Mfg. Co., Inc., James 38A

N.R.K. Mfg. & Engineering Co. 148A
Nassau Research & Dev. Assoc., Inc. (Narda) 154A
National Union Radio Corp. (Research Div.) 133A
New London Instrument Co. 136A
New York Transformer Co., Inc. 72A
Ney Company, J. M. 116A
Norden Laboratories Corp. 137A
North American Aviation, Inc. 131A
Northern Electric Co. Ltd. 91A

Ohmite Mfg. Co. 30A

PSC Applied Research Ltd. 157A
Panoramic Radio Products, Inc. 80A
Pickard & Burns, Inc. 157A
Pickard & Burns, Inc. 118A
Plastic Capacitors, Inc. 149A
Polarad Electronics Corp. 59A
Polymer Corp. of Pennsylvania 108A
Polytechnic Research & Dev. Co., Inc. 95A
Potter Instrument Co., Inc. 32A
Precision Paper Tube Co. 69A

Radio Corp. of America (Empl.) 129A
Radio Corp. of America (Tubes) 64A
Radio Engineering Co. 152A
Radio Materials Corp. 79A
Radio Receptor Co., Inc. 17A
Rauland Corp., The 75A
Raytheon Mfg. Co. (Rec. Tubes) 5A
Relay Sales Corp. 103A
Remington Rand, Inc. (Eckert-Mauchly Div.) 137A
Remler & Co. Ltd. 106A
Rosen Engineering Products, Inc., Raymond 126A
Rosenberg Associates, Paul A. 157A

Sandia Corp. 141A
Sangamo Electric Co. 112A
Secon Metals Corp. 98A
Servomechanisms, Inc. 86A
Set Screw & Mfg. Co. 153A
Shallcross Mfg. Co. ....6A & 7A
Southwestern Industrial Electronics Co. 69A
Speer Resistor Corp. 93A
Spencer-Kennedy Labs., Inc. 153A
Sperry Gyroscope Co. 134A
Sperry Products, Inc. 140A
Sprague Electric Co. 1A
Stackpole Carbon Co. 9A
Standard Piezo Co. 153A
Stavid Engineering, Inc. 134A
Stoddart Aircraft Radio Co. 104A
Sturtevant Co., P. A. 95A
Superior Electric Co. 97A
Surprenant Mfg. Co. 119A
Sylvania Electric Products Inc. (Tung. & Chem.) 20A
Sylvania Electric Products Inc. (Parts Div.) 36A
Sylvania Electric Products Inc. (Empl.) 141A
Synthane Corp. 43A

Technology Instrument Corp. 146A
Teiner Co., Inc., Roland 147A
Tektronix, Inc. 56A
Tel-Instrument Co., Inc. 96A
Telechrome, Inc. 157A
Telewave Labs., Inc. 106A
Telrex Inc. 157A
Terpening Co., L. H. 144A
Times Facsimile Corp. 156A
Transistor Products, Inc. 142A
Transradio, Ltd. 99A
Trans-Sonics, Inc. 142A
Triplett Electrical Inst. Co. 40A
Truscon Steel Co. 48A
Tung-Sol Electric, Inc. 67A

United States Gasket Co. 160A
United Transformer Co. ....Cov. III

Varian Associates 109A
Victoreen Instrument Co. 143A

Waterman Products Co., Inc. 78A
Weston Electrical Instr. Corp. 46A
Wheeler Laboratories, Inc. 157A
White Dental Mfg. Co., S. S. 122A
Wilcox Electric Co., Inc. 47A
Wilcox Electric Co., Inc. (Empl.) 134A
Wincharger Corp. 150A

Zophar Mills, Inc. 151A

UNITED STATES GASKET CO.

is the foremost source for TEFLON and KEL-F sheets, rods, tape, tubing, bars, cylinders and parts, custom-molded and machined to exact specifications

The United States Gasket Company was one of the pioneers in the fabrication of Fluorocarbon Plastics.

- Profit from this broad experience, greater "Know-how" and their completely modern specialized facilities for low-cost, close tolerance production of Teflon* and Kel-F† Stock and custom-molded or machined parts.
- If you have a problem, U.S.G. engineers will show you how to cut corners and costs to incorporate the superior qualities of these plastics in your products.
- Ask for Catalogs No. 300 and 500.

**du Pont Trademark* *†W. M. Kellogg Trademark*

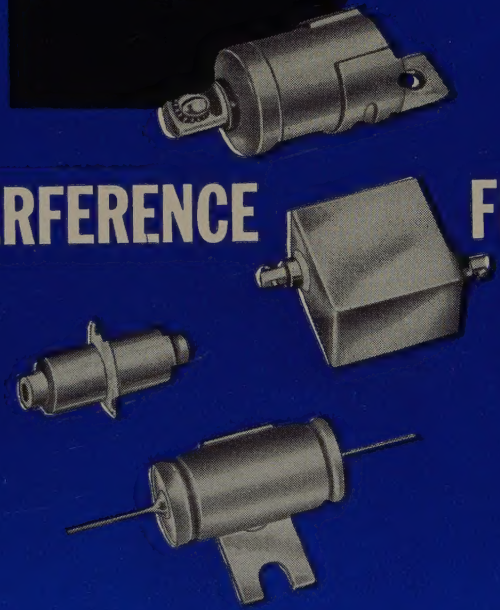
UNITED STATES GASKET COMPANY

FLUOROCARBON PRODUCTS DIVISION
CAMDEN 1, NEW JERSEY

Representatives in Principal Cities Throughout the World

Consistently Dependable

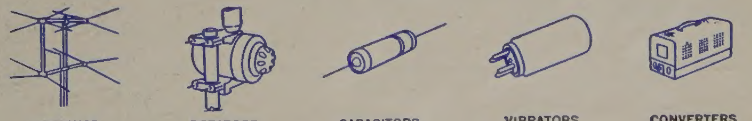
INTERFERENCE FILTERS



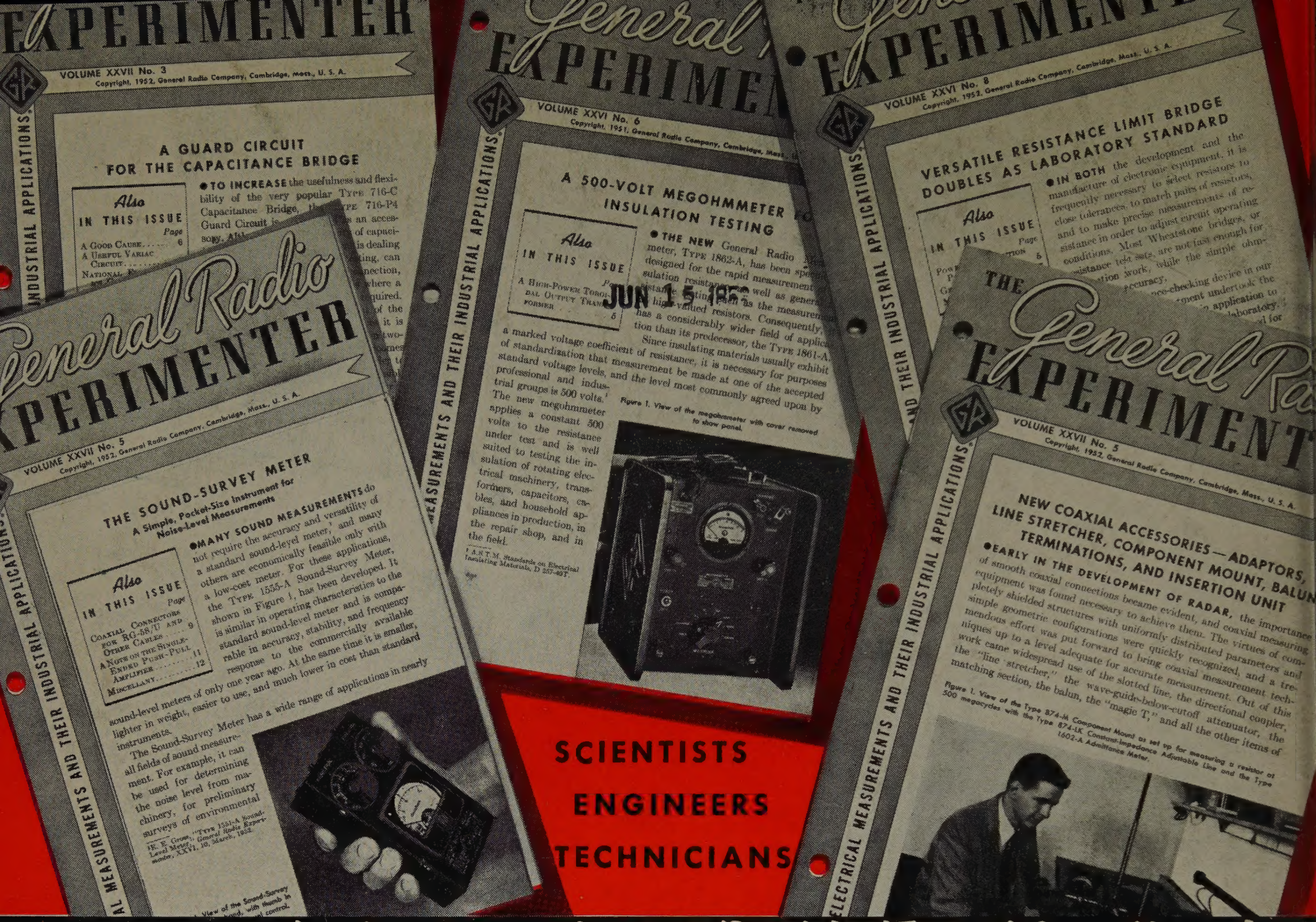
There's a C-D for every known interference problem! Did you know that C-D makes and sells more interference filters than any one else? Chances are the solution to your filter problem is already waiting for you in our files. If we don't have the answer, we'll find it for you. Write for catalog to: **Dpt. M-63,** General Offices, Cornell-Dubilier Electric Corporation, South Plainfield, New Jersey.

CORNELL-DUBILIER

world's largest manufacturers of filters



SOUTH PLAINFIELD, N. J. • NEW BEDFORD, WORCESTER AND CAMBRIDGE, MASS. • PROVIDENCE, R. I. • INDIANAPOLIS, IND. • FUQUAY SPRINGS, N. C. • SUBSIDIARY, THE RADIART CORP., CLEVELAND, O.



General Radio EXPERIMENTER

VOLUME XXVII No. 3
Copyright, 1952, General Radio Company, Cambridge, Mass., U. S. A.

MEASUREMENTS AND THEIR INDUSTRIAL APPLICATIONS

A GUARD CIRCUIT
FOR THE CAPACITANCE BRIDGE

Also IN THIS ISSUE — Page
A Good Cause 6
A Useful Variac Circuit . . . . .
National

● TO INCREASE the usefulness and flexibility of the very popular Type 716-C Capacitance Bridge, th ... ype 716-P4 Guard Circuit i ... s an accessory ... of capaci... is dealing ... ting, can ... nection, ... where a ... quired. ... of the ... it is ... two-

General Radio EXPERIMENTER

VOLUME XXVI No. 6
Copyright, 1951, General Radio Company, Cambridge, Mass.

A 500-VOLT MEGOHMMETER FO
INSULATION TESTING

Also IN THIS ISSUE — Page
A High-Power Toroidal Output Transformer . . . 5

JUN 1 5 1952

● THE NEW General Radio Megohmmeter, Type 1862-A, has been spe... designed for the rapid measurement of insulation resistance ... sistance testing ... well as general ... high-valued resistors. Consequently, ... has a considerably wider field of applica... tion than its predecessor, the Type 1861-A.

Since insulating materials usually exhibit a marked voltage coefficient of resistance, it is necessary for purposes of standardization that measurement be made at one of the accepted standard voltage levels, and the level most commonly agreed upon by professional and industrial groups is 500 volts.¹ The new megohmmeter applies a constant 500 volts to the resistance under test and is well suited to testing the insulation of rotating electrical machinery, transformers, capacitors, cables, and household appliances in production, in the repair shop, and in the field.

Figure 1. View of the megohmmeter with cover removed to show panel.

[1] A.S.T.M. Standards on Electrical Insulating Materials, D 257-49T.

General Radio EXPERIMENTER

VOLUME XXVI No. 8
Copyright, 1952, General Radio Company, Cambridge, Mass., U. S. A.

VERSATILE RESISTANCE LIMIT BRIDGE
DOUBLES AS LABORATORY STANDARD

Also IN THIS ISSUE — Page

● IN BOTH the development and the manufacture of electronic equipment, it is frequently necessary to select resistors to close tolerances, to match pairs of resistors, and to make precise measurements of resistance in order to adjust circuit operating conditions. Most Wheatstone bridges, or resistance test sets, are not fast enough for ... tion work, while the simple ohm... accuracy, ... nce-checking device in our ... ment undertook the ... n application to ... laboratory. ... d for

General Radio EXPERIMENTER

VOLUME XXVII No. 5
Copyright, 1952, General Radio Company, Cambridge, Mass., U. S. A.

THE SOUND-SURVEY METER
A Simple, Pocket-Size Instrument for Noise-Level Measurements

Also IN THIS ISSUE — Page
Coaxial Connectors for RG-58/U and Other Cables 9
A Note on the Single-Ended Push-Pull Amplifier 11
Miscellany 12

● MANY SOUND MEASUREMENTS do not require the accuracy and versatility of a standard sound-level meter,¹ and many others are economically feasible only with a low-cost meter. For these applications, the Type 1555-A Sound-Survey Meter, shown in Figure 1, has been developed. It is similar in operating characteristics to the standard sound-level meter and is comparable in accuracy, stability, and frequency response to the commercially available sound-level meters of only one year ago. At the same time it is smaller, lighter in weight, easier to use, and much lower in cost than standard instruments.

The Sound-Survey Meter has a wide range of applications in nearly all fields of sound measurement. For example, it can be used for determining the noise level from machinery, for preliminary surveys of environmental

[1] R. E. Gross, "Type 1551-A Sound-Level Meter," General Radio Experimenter, XXVI, 10, March, 1952.

... View of the Sound-Survey ... hand, with thumb in ... control.

THE General Radio EXPERIMENTER

VOLUME XXVII No. 5
Copyright, 1952, General Radio Company, Cambridge, Mass., U. S. A.

NEW COAXIAL ACCESSORIES — ADAPTORS,
LINE STRETCHER, COMPONENT MOUNT, BALUN
TERMINATIONS, AND INSERTION UNIT

● EARLY IN THE DEVELOPMENT OF RADAR, the importance of smooth coaxial connections became evident, and coaxial measuring equipment was found necessary to achieve them. The virtues of completely shielded structures with uniformly distributed parameters and simple geometric configurations were quickly recognized, and a tremendous effort was put forward to bring coaxial measurement techniques up to a level adequate for accurate measurement. Out of this work came widespread use of the slotted line, the directional coupler, the "line stretcher," the wave-guide-below-cutoff attenuator, the matching section, the balun, the "magic T," and all the other items of

Figure 1. View of the Type 874-M Component Mount as set up for measuring a resistor at 500 megacycles with the Type 874-LK Constant-Impedance Adjustable Line and the Type 1602-A Admittance Meter.

You Can Receive the GR EXPERIMENTER Without Charge!

Since 1926, the General Radio EXPERIMENTER has been sent without charge to thousands of persons interested in new developments in audio and communication-frequency techniques. This monthly periodical features descriptions of latest circuit developments, details of new G-R laboratory instruments and accounts of interesting applications. Included are articles on electronic instrumentation, and control devices for the solution of practical industrial problems.

Recent issues have featured:

- **A versatile new Resistance-Limit Bridge**
- **Industrial and medical applications of the GR Sound-Survey Meter**
- **Means of simulating a noisy signal from a typical radar receiver by adding a video pulse to the output of a Random Noise Generator**
- **A new Guard Circuit for the measurement of dielectric properties and for improving accuracy of three terminal measurements**
- **An Impedance Bridge used for detecting a leak in a concrete pipe at the bottom of the Detroit River**

GENERAL RADIO Company, 275 Massachusetts Avenue
Cambridge 39, Massachusetts
558

Please enter my complimentary subscription to the G-R EXPERIMENTER

Name____________________

Business Address____________________
Street

City____________________ Zone__________ State__________

Position (or title)____________________

For Your Complimentary Subscription
to the G-R EXPERIMENTER
Fill in this Coupon NOW

GENERAL RADIO Company
275 Massachusetts Avenue, Cambridge 39, Massachusetts, U. S. A.
90 West St. NEW YORK 6 · 920 S. Michigan Ave. CHICAGO 5 · 1000 N. Seward St. LOS ANGELES 38